ER3000 Electronic Pressure Controller

User Manual

TESCOM

EMERSON
Process Management

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Installation & Operation Precautions

TESCOM Industrial Controls

INTRODUCTION

Prior to installing or operating any equipment, read and follow all the information listed. Improper application and operation can result in damage to equipment or severe personal injury.

All possible hazards and precautionary measures cannot be covered here. It is recommended that prior to using this equipment, you fully understand and comply with existing safety regulations.

OXYGEN SERVICE

Specification of the materials in regulators used for oxygen service is the USER'S RESPONSIBILITY. Cleaning for oxygen service to 3000 PSIG is supplied standard by Tescom at no additional cost for mechanical regulators. Cleaning for service above 3000 PSIG may be contracted through an outside source.

COMPATIBILITY

Tescom may suggest material for use with specific media upon request. Suggestions are based on technical compatibility resources through associations and manufacturers. Tescom does NOT guarantee materials to be compatible with specific media - THIS IS THE RESPONSIBILITY OF THE USER! Users must test under operating conditions to determine suitability of materials in an application.

PRESSURE RATING

Verify the designed pressure rating of the equipment. Check supply lines, fittings, connections, filters, valves and gauges. All must be adequate for the supply and operating pressure.

RELIEF PROTECTION

A regulator is not intended to be used as a shut-off device. A pressure relief device should be installed downstream of the regulator to protect the process equipment in the case of a rise in operating pressure. When the regulator is not in use, the supply pressure should be closed.

FILTRATION

An auxiliary upstream filter is recommended for use in all media. Gaseous media should be free of excessive moisture to prevent icing of the equipment.

MAINTENANCE

Periodic inspection and scheduled maintenance of your equipment is essential for continued safe and satisfactory operation. The frequency of servicing will depend on the application.

REPAIR SERVICE

Any equipment in need of service should be returned to your equipment supplier for evaluation and prompt service. If repairable, your equipment will be restored to the original factory performance specifications. A flat fee repair charge has been established for each standard model and the original equipment warranty will be reinstated after a complete overhaul.

ASSEMBLY/INSTALLATION DRAWINGS & BILLS OF MATERIAL

Drawings and parts lists for your product may be obtained by calling 1(800) 447-1204. Tescom will provide these by fax or mail. Your local distributor can provide additional assistance.

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ER3000 USER MANUAL

1. INTRODUCTION

The ER3000 (Electronic Regulator) is a versatile 0 to 100 psi pressure controller. It can be used in conjunction with any pneumatically actuated regulator or valve to control pressure from subatmosphere to 20,000 psi with Cv's of up to 45.

Setpoints can be provided via an analog input (4-20mA, 1-5V, or 0-10V), the digital RS485 interface, or a downloaded profile.

The RS485 interface makes pressure control by a computer easier than ever before. The controller can be wired quickly into the standard serial communication port found on any PC using a low-cost RS232 to RS485 adapter.

This communication channel also provides for the programming of a number of internal parameters, including PID tuning variables, zero and span, mode of operation, limits, etc.

Feedback can be derived either from the ER3000's internal temperature compensated sensor or an external transducer (4-20mA, 1-5V, or 0-10V). This second option allows for positioning the sensor downstream in the actual process line.

Four modes of operation are available. Internal feedback mode (which makes the controller an I/P when analog setpoints are used) and uses the internal sensor as the source of feedback. External feedback mode uses an external sensor as the feedback. Cascade mode creates a loop within a loop; the inner loop uses the internal sensor for feedback and the outer loop uses the external transducer for feedback. Manual mode allows for direct control of the solenoid valves (useful for troubleshooting the system).

In summary, the ER3000 electronic pressure regulator is easy to get up and running, yet offers the flexibility required by the most demanding user.

2. SPECIFICATIONS

2.1 Enclosure

NEMA 4X.

To prevent any interference from electromagnetic radiation, use rigid metal conduit to enclose the wiring entering the ER3000. Two 1/2NPT wire ports have been provided for this purpose. If unused, properly seal with a metal plug.

2.2 Media

The preferred media is clean, dry instrument grade air or nitrogen. Use of an in-line 40-micron filter is highly recommended to prevent damage to the solenoid valves.

2.3 Inlet Pressure

Minimum:	Outlet pressure + 1 PSIG.
Maximum:	120 PSIG.
Typical:	110 PSIG.

Note: Response time is affected by input pressure.

2.4 Environment

Temperature:	-30ºC to 75°C (Dry nitrogen supply gas). -20ºC to 60ºC (KEMA Explosion Proof Versions M & N) 5ºC to 75°C (Shop air).
Pressure:	28 - 32 inches Hg
Humidity:	To 100% R.H (non-condensing) @ 0°C to 75ºC.

2.5 Flow Rate

Cv:	0.01.

Note: The flow rate can be increased using a booster regulator.

2.6 Power Requirement

Voltage:	24V (22V to 28V)
Current:	340mA Max, 180mA Nominal

2.7 RS485 Communication Interface

Networking:	Up to 32 controllers on one network.
Cable length:	4000 ft. Max.
Baud rate:	9600

2.8 Accuracy

Room temp.:	0.1% of span max
Temp. effects:	0.002%/°F of span max.

2.9 Response Time

Rise Time:	257ms. - 10 psi to 90 psi
Fall Time:	552ms. - 90 psi to 10 psi

Note: Step response into dead-end system (1 cubic inch volume).

2.10 Ports

Conduit:	1/2” NPT
Pneumatic:	1/8” NPT - Inlet, exhaust and gauge ports.
	1/4” NPT - Controlled outlet port.

2.11 Weight

34.8 oz. (1.0 kg).

2.12 External Analog Input Impedance

4-20mA:250Ω

1-5V:	220KΩ - Single Input Pin to Gnd.
	1.7MΩ - Differential Input
0-10V:	100KΩ

2.13 Digital Outputs

Current:	50 mA Continuous, 100 mA Instantaneous
Voltage:	5V - 28V
Type:	Open collector, grounded emitter

2.14 Digital Inputs

Voltage Range/Input Impedance:

4-20 mA:	250Ω
1-5V:	220KΩ - Single Input Pin to Gnd.
	1.7MΩ - Differential Input
0-10V:	100KΩ

Type: Level Sensitive

2.15 Analog Output

4-20mA:0.5% Accuracy

2.16 Sensor Update Rate

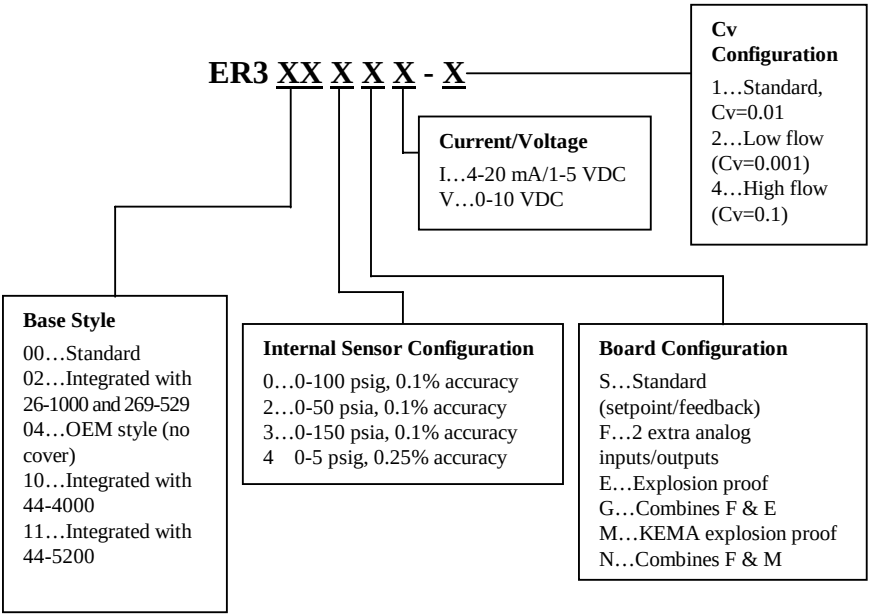
25ms:	Rate of sensor reading and processing task

3. ER3000 PART NUMBERING SYSTEM

Standard features:

- RS485 communications included.
- 1/8" inlet and exhaust ports, 1/4" controlled output port.
- Maximum inlet pressure = 120 psig.
- 0 to 100 psig internal sensor.
- Windows/DOS software package included.
- 24 VDC power required.

As the table below indicates, other sensor ranges are available. Please consult the factory for special modifications or requirements.



4. INSTALLATION

The ER3000 has a number of variations and wiring options. The following pages of the installation section detail a typical installation and many of those options.

Note: Installation of explosion proof models shall be in accordance with the specifications of the standards shown on the metal tag.

4.1 Interface Cable Assemblies

The following tables give the complete wiring layout of the ER3000 wiring assemblies, which are connected to the J3 and J4 terminal blocks. Refer to the tables to ensure proper wiring of external devices.

Note: The (+) and the (-) refer to the differential inputs. Both must be connected for the system to work properly.

Table 1: Main Cable Assembly

J3 Pins	Description	Color
1	+Setpoint Input.	Brown
2	-Setpoint Input.	Red
3	+Feedback Input.	Orange
4	-Feedback Input.	Yellow
5	-RS485 Network connection.	Green
6	+RS485 Network connection.	Blue
7	+ 24 Volt DC Power.	Violet
8	24 Volt Return, (Power Ground).	Gray
9	+5 Volt output (5mA Max.).	White
10	Analog Signal Ground.	Black
11*	Analog Signal Output.	Pink
12	Analog Signal Ground.	Tan

Table 2: Auxiliary Cable Assembly (ER3000F and ER3000G models)

J4 Pins	Description	Color
1	+Aux. Input #1.	Brown
2	-Aux. Input #1.	Red
3	+Aux. Input #2.	Orange
4	-Aux. Input #2.	Yellow
5	Analog Signal Ground.	Green
6	Digital Output Ground.	Black
7	Digital Output #1.	Blue
8	Digital Output #2.	White

* Active in ER3000F and ER3000G Models only.

4.2 Voltage/Current Select Jumpers

Figure 1 shows the J5 voltage/current select jumpers location on the ER3000. Use them to select between 4-20mA and 1-5V. The 0-10V models of the ER3000 do not have the jumpers.

The jumper on the bottom board is for factory installation of the embedded software only and the jumper should not be installed for normal operation.

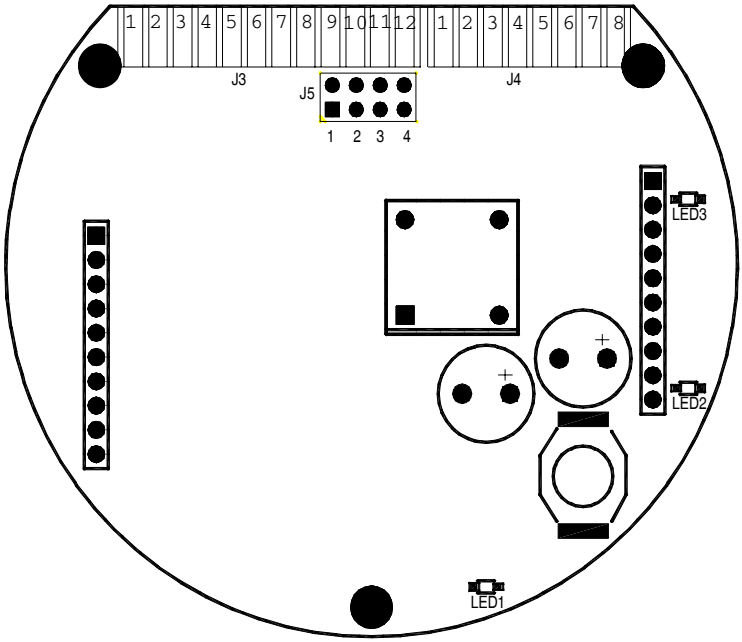


Figure 1: Voltage/Current Select Jumpers

Jumper J5 (top board) - Voltage/Current Select (not on 0-10V models)

1: Analog Setpoint
2: External Feedback
3: Auxiliary input #1
4: Auxiliary input #2

For all the above jumper positions:

Jumper not installed - configured for 1-5V input.
Jumper installed - configured for 4-20mA input.

LED's

Refer to Section 10.1, LED Indicators, for an explanation of the LED indicators.

4.3 Basic ER3000 to PC Wiring

The necessary wiring for the ER3000 communicating to a PC is shown in Figure 2. A PC is typically used to communicate to the ER3000 digitally, but any device capable of the interface protocol could be used, such as a PLC.

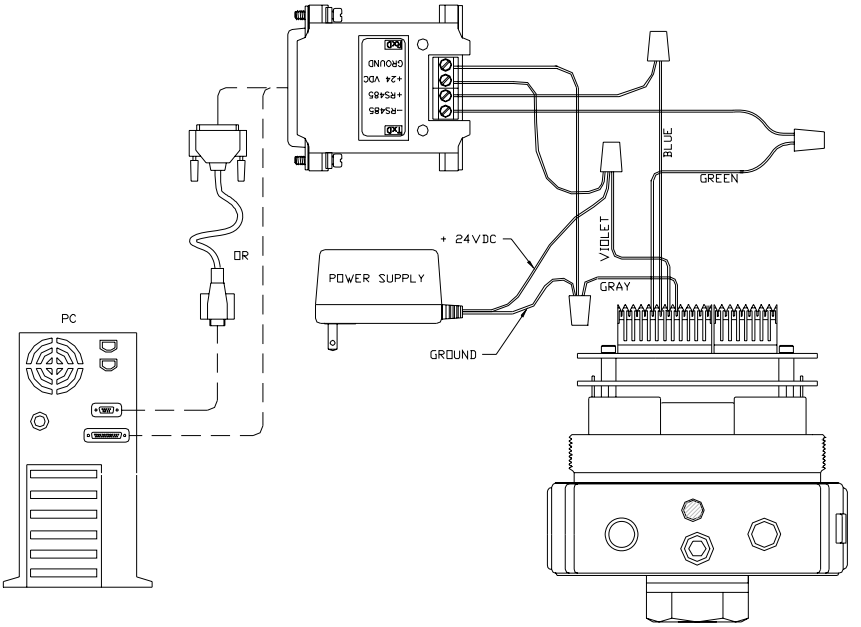


Figure 2: ER3000 Basic Wiring Diagram

4.4 Setting up a Typical ER3000 Pressure Control System

One of the most commonly used modes of operation is shown in Figure 3. The configuration shows the ER3000 with a 24 Volt power supply, pressure regulator, 4-20mA transducer, RS232/RS485 converter, and an optional 25-9 pin adapter cable.

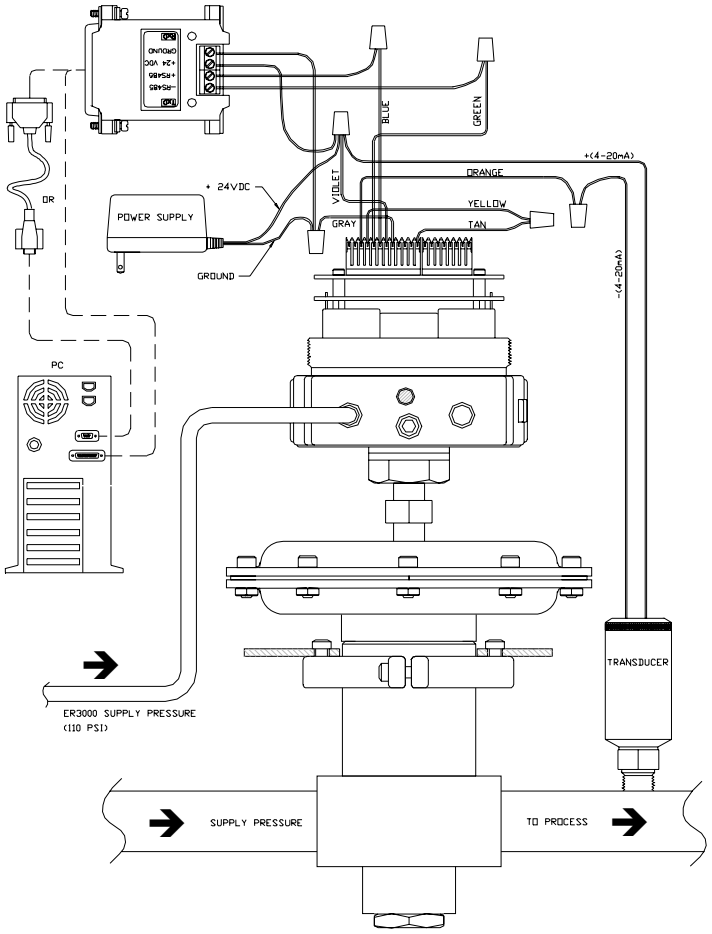


Figure 3: ER3000 Typical System Wiring Diagram

4.4.1 Plumb the External Regulator and Transducer

If higher pressures or flows are required by the application or it is necessary to isolate the controller from the process media, an air actuated mechanical regulator can be used to boost the output and/or provide isolation.

Additionally, an external transducer may be used to sense the process pressure supplied by the external regulator.

4.4.2 Mount the ER3000

Four 8-32 UNC screw holes are provided for the physical mounting of the ER3000. For details, reference mechanical drawings at the back of the manual.

4.4.3 Connect the Power Supply

Connect a 24 Volt power supply to the ER3000, as shown in Figure 2.

Power up the ER3000.

Visually check the LED indicators to ensure that power is supplied to the ER3000. The red LED, LED1, on the top board should be ON indicating power applied and the red LED, LED1, on the bottom board should be blinking indicating the embedded software is running.

Power down the ER3000.

4.4.4 Connect RS485 Interface Connections

Connect the ER3000 to the Tescom RS232/RS485 converter, as shown in Figure 2. Consult our Troubleshooting section if using a third party converter, not all converters are capable of the mode of operation expected by our software.

Connect the RS485 converter directly to a COMM port (default=COM2) of the computer, if necessary include the 25 to 9 pin adapter cable.

4.4.5 Install the "ER3000 (CVI)" Windows Program

Insert the "ER3000 User Software" CD into your PC and the install program should start automatically. If it does not, choose and run the "autorun" executable on the CD. Click on the INSTALL button in the "CD Menuing System" menu to get to the "Installation Menu". From the "Installation Menu", chick on the Windows Tune (32 BIT) button. Follow the on-screen instructions during the installation process. The installation will automatically create the directory ER3000 and install the Windows Tune program, including support files (e.g. TESCOM.DLL).

The Windows program contains a complete online help manual and a manual.rtf file of all the online help pages that may be easily printed out.

4.4.6 Communicate to the ER3000, using the ER3000 (CVI) Windows Program

Power up the ER3000.

Execute the ER3000 (CVI) program. The program is executed by pressing the Start button, choosing the Programs menu, choosing the ER3000 (CVI) folder, and then selecting the ER3000 (CVI) program. If an error occurs, go to the Troubleshooting section.

Power down the ER3000.

4.4.7 Connect Transducer Wiring

If the downstream process pressure regulation is required by the application, a pressure transducer can be used to provide a 4-20mA, 1-5V, or 0-10V feedback signal. Figure 3 shows wiring for a 2-wire 4-20mA transducer. The wiring of three and four wire transducers are shown in section 4.5.1, Transducer Wiring Configurations.

Check to ensure that the external feedback voltage/current select jumper is installed for 4-20mA or removed for 1-5V operation. There is no jumper on the 0-10V external feedback ER3000 models.

4.4.8 Connect Pressure to the System

Figure 3 illustrates the typical pressure connections for the ER3000. The ER3000 inlet pressure is the supply pressure (max 120 psi). The exhaust port on the ER3000 is used for venting when a pressure reduction is required. The inlet pressure to the regulator depends on the capability of the regulator and the system requirements. The output pressure is the regulated pressure being supplied to the process.

The gauge port can have a pressure gauge attached or simply plugged. If desired, the gauge port can be used as the output (the normal output port must then be plugged).

4.4.9 Tune the System

The system should now be fully installed. The system performance can be checked using the Windows ER3000 (CVI) program or the DOS Tune program provided. The tuning parameters can be updated using these programs to alter the ER3000 and system performance. Refer to the Tuning Procedure section for details on tuning the pressure control system.

4.5 Additions and Variations to the Typical System

This section shows variations and additions to the Typical ER3000 control system shown in Figure 3. Alternatively, use Figure 2 as a baseline for systems without an external transducer.

4.5.1 Transducer Wiring Configurations

The wiring for the two-wire transducer is shown in Figure 3.

The wiring for the three wire and four wire transducers are shown in Figure 4 and Figure 5 respectively. Connect the ER3000 to the transducer, or other feedback source, as shown in the respective diagrams.

Check to ensure that the external feedback voltage/current select jumper, J5:2, is installed for 4-20mAmp or removed for 1-5 Volt operation. There is no jumper on the 0-10 Volt ER3000 models.

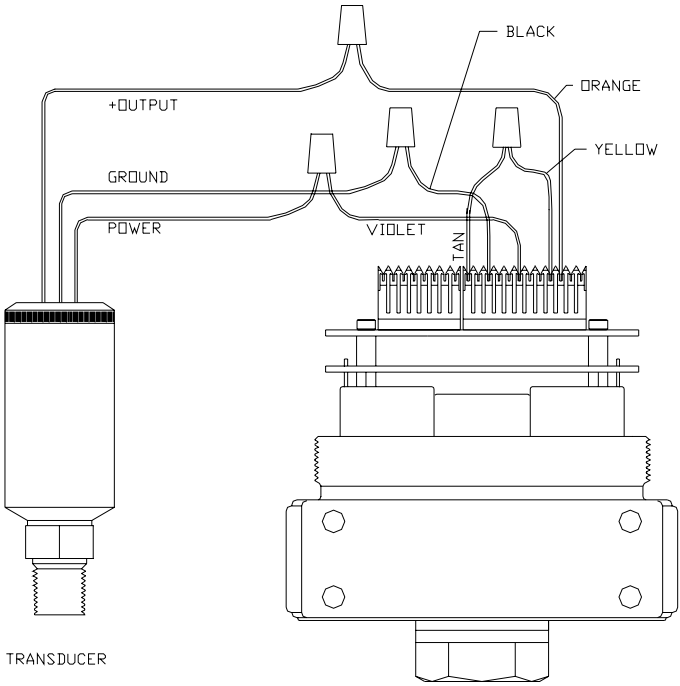


Figure 4: Three-Wire External Feedback Cabling
NOTE: Wire power as shown in figures 2 & 3

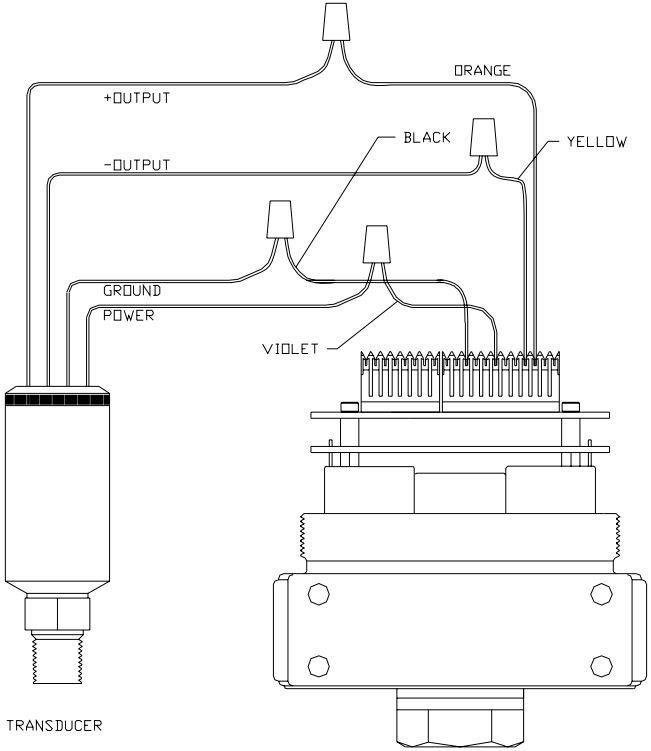


Figure 5: Four-Wire External Feedback Cabling
NOTE: Wire power as shown in figures 2 & 3

4.5.2 Analog Setpoint Source

Check to ensure that the analog setpoint voltage/current select jumper, J5:1, is installed for 4-20mA or removed for 1-5V operation. There is no jumper on the 0-10V external feedback models. Figure 6 and Figure 7 show how to provide a 4-20mA analog setpoint from a PC D/A card or a PLC D/A module.

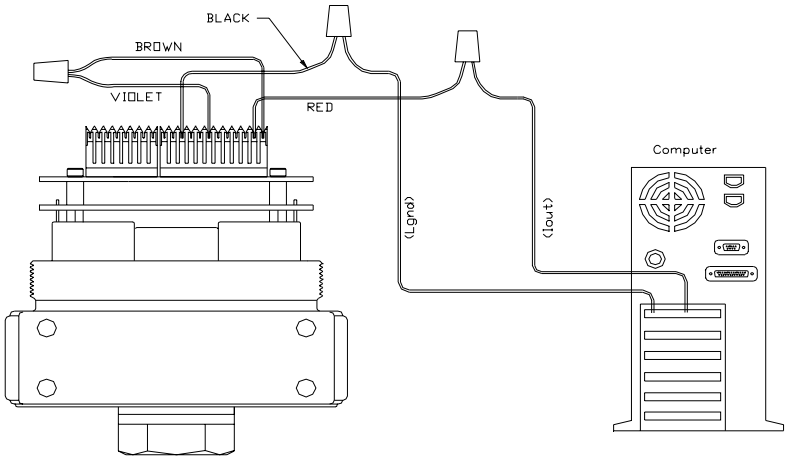


Figure 6: Passive PC or PLC D/A Card Analog Setpoint (4-20mA)
NOTE: Wire power as shown in figures 2 & 3

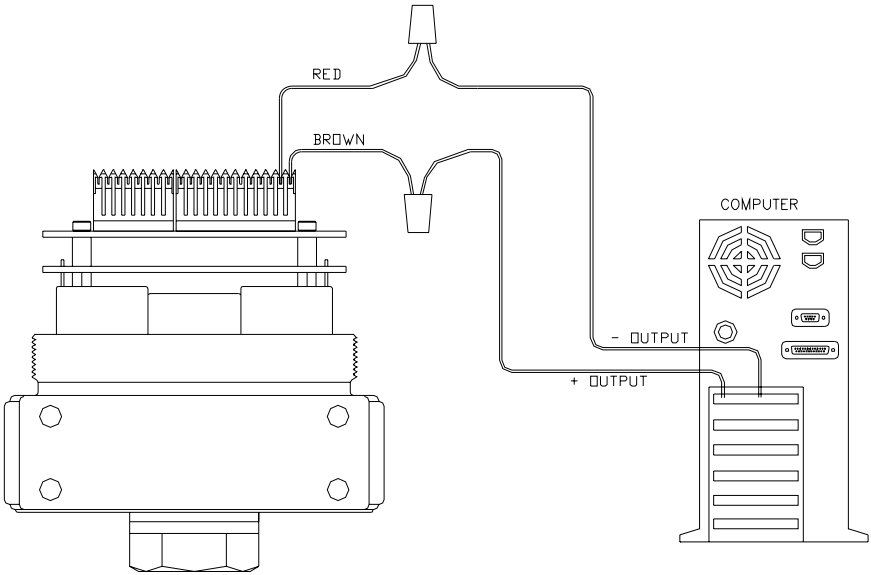


Figure 7: Active PC or PLC D/A Card Analog Setpoint (4-20mA, 1-5V, 0-10V)
NOTE: Wire power as shown in figures 2 & 3

Figure 8 shows how to provide a 0-5V signal to the analog setpoint from a potentiometer. The 0-1V range can be programmed to be a failsafe condition for 1-5V ER3000's. Refer to section 5.4, Failsafe Limits, for more information on failsafe.

Note: The ER3000 cannot directly provide a 0-10 volt signal. An external 10-volt supply must be used for power.

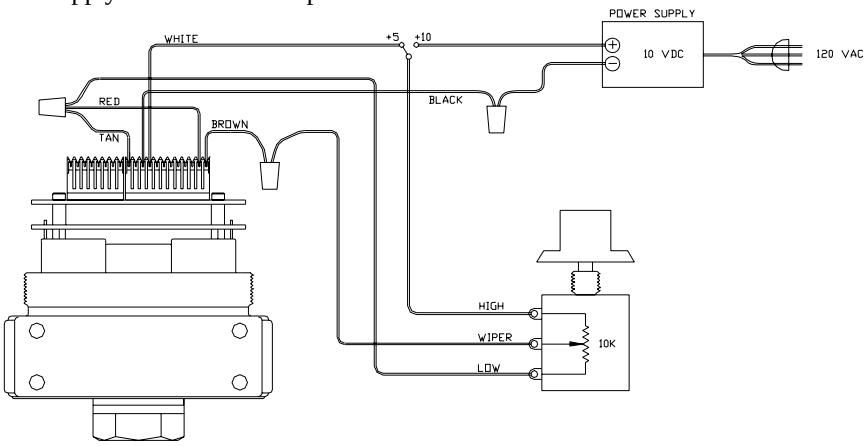


Figure 8: Potentiometer Analog Setpoint
NOTE: Wire power as shown in figures 2 & 3

Figure 9 shows how to provide the analog setpoint from an active variable current supply.

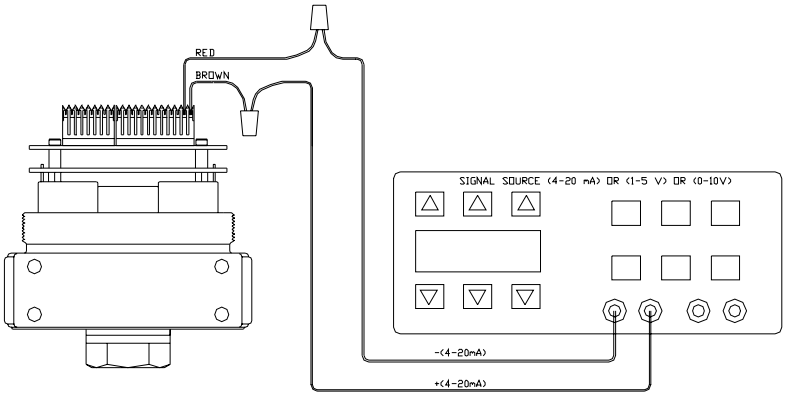


Figure 9: Current/Voltage Analog Setpoint
NOTE: Wire power as shown in figures 2 & 3

Figure 9 also can represent how to provide a 1-5V/0-10V analog setpoint. The negative lead (-) of your source connects to the red wire and the positive lead (+) connects to the brown wire.

4.5.3 Monitor the Feedback Signal

The feedback signal can be monitored using an A/D card in the PC, or a PLC. Although, currently available through the RS485 interface, the user may find it more convenient to directly read the transducer analog output. This would be beneficial when adding to existing system software which performs system control, data acquisition, etc.

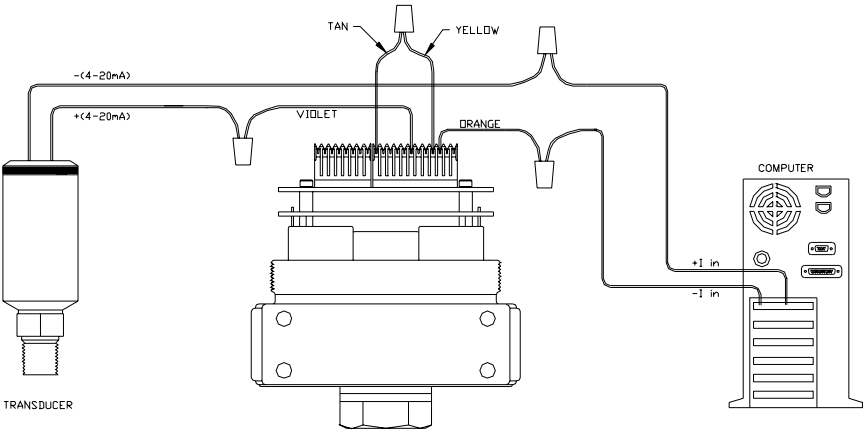


Figure 10: Monitor 4-20mA External Feedback (Floating Input)
NOTE: Wire power as shown in figures 2 & 3

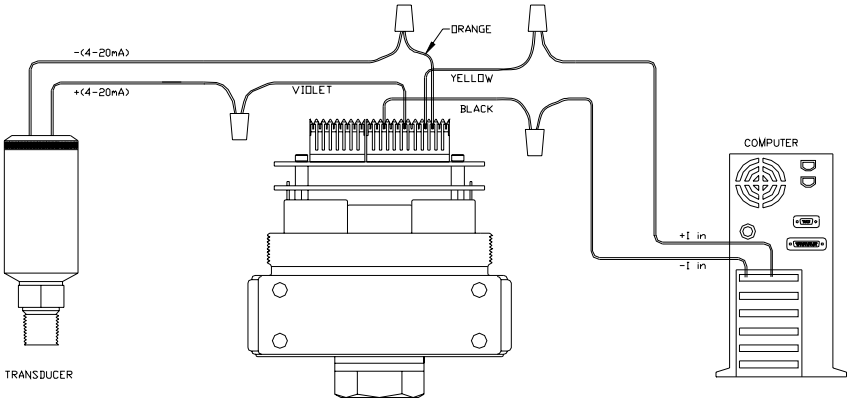


Figure 11: Monitor 4-20mA External Feedback (Ground Referenced Input)
NOTE: Wire power as shown in figures 2 & 3

In order to avoid producing ground loops, it may be necessary in some systems to monitor the voltage produced across the ER3000's internal 250 Ω resistor rather than breaking into the 4-20 mAmp loop.

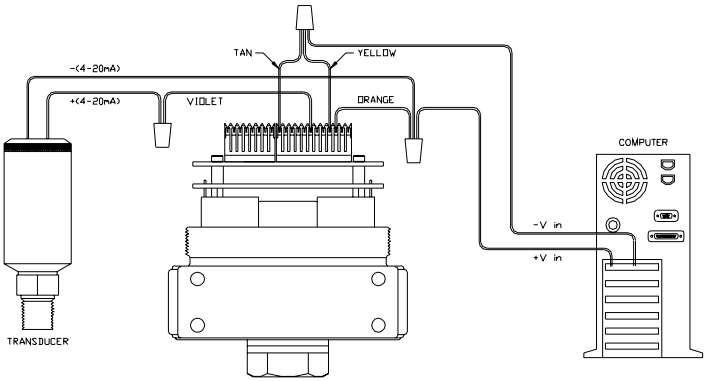


Figure 12: Monitor voltage produced by 4-20 mAmp External Feedback
NOTE: Wire power as shown in figures 2 & 3

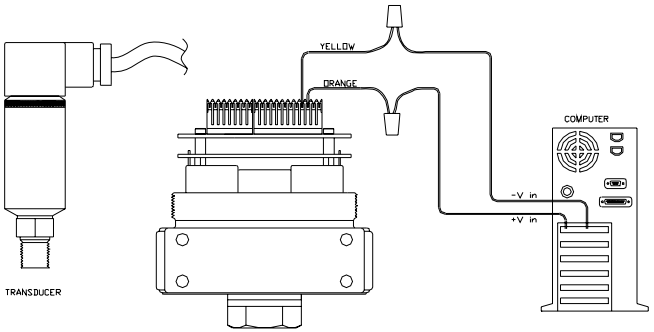


Figure 13: Monitor 1-5V/0-10V External Feedback
NOTE: Wire power as shown in figures 2 & 3

The wiring from the transducer is dependant on whether it is a 3-wire or 4-wire transducer. Refer to Figure 4 and Figure 5 for 3-wire and 4-wire transducer wiring schemes.

4.5.4 Profile Control / Digital Inputs

This feature is only available on models that have the extra analog inputs, as referenced in section 3 (ER3000 Model Descriptions).

Figure ***14*** shows a simple wiring method of controlling a profile, without the need for a computer. Once the profile is downloaded into the ER3000, it can be started or stopped with a toggle switch. The Digital Input pushbutton may be used if the "Digital Input" function has been used within the profile. This allows an operator the flexibility to wait until an event has occurred like changing to the next device.

An additional feature, necessary for some demanding applications, is provided for by the Profile Start/Stop and Digital Input signals, which are the Extra Analog Input 1 and Extra Analog Input 2 inputs of the ER3000. This feature is the ability to adjust the toggle level (or trip point) of the analog input where it switches between a logical 0 and a logical 1. The ER3000 toggle variables enable this feature and are described in section 9.5, Analog Input Variables. For example, this feature allows connecting a pressure transducer to the Digital Input and waiting for a specific pressure before continuing on in the pressure profile.

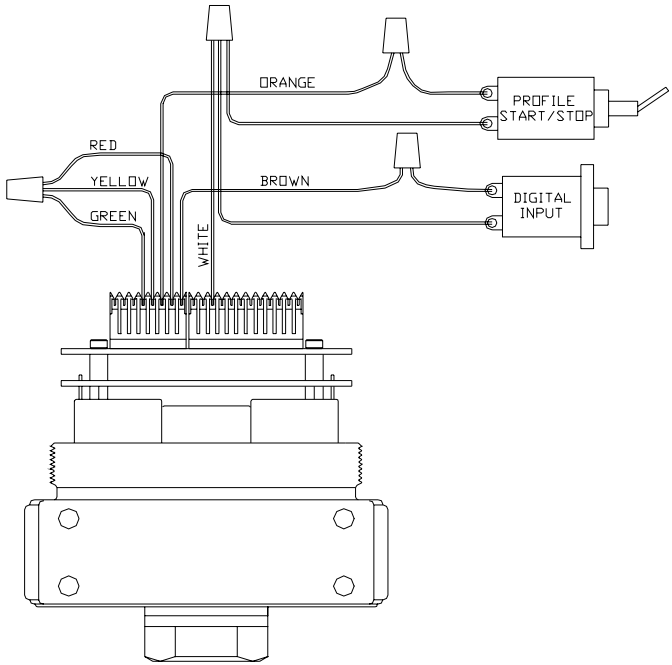


Figure 14: External Profile Control
NOTE: Wire power as shown in figures 2 & 3
(J5 jumpers 3 and 4 must be removed, refer to Figure 1)

4.5.5 Switch Feedback Control to a Second Feedback Source

The feedback source can be easily switched between two feedback sources by writing to variable 87 (ID_EXT_FEEDBACK_SOURCE) in the ER3000. This may be quite beneficial if trying to control at two very different pressures, e.g. 80 psi and 8000 psi. Transducer 1 could be a 10,000 psi transducer and Transducer 2 could be a 100 psi transducer.

This feature is only available on ER3000 models that have the extra analog inputs, as referenced in Section 3 (ER3000 Model Description).

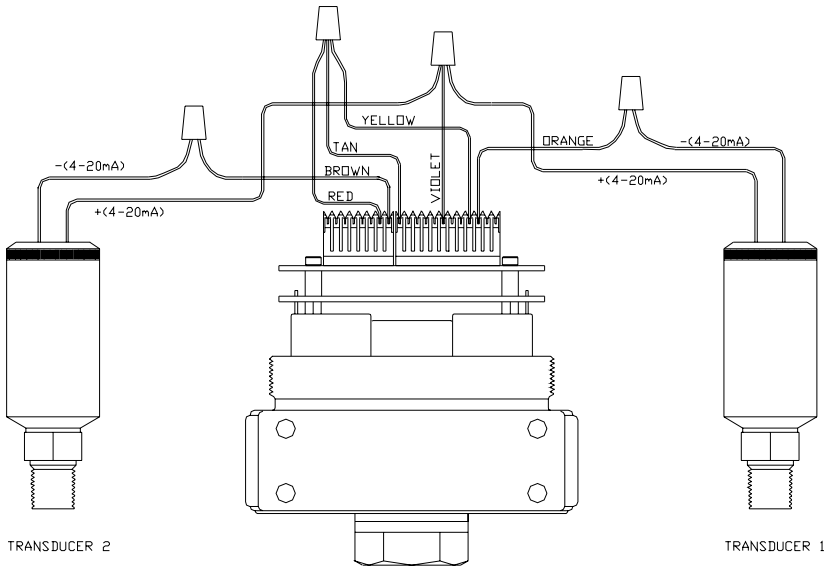


Figure 15: Switch between two External Feedback Sources
NOTE: Wire power as shown in figures 2 & 3

4.5.6 Monitor Analog Signals

The ER3000 can monitor a number of analog signals. This is quite useful in data acquisition systems to perform trend analysis on the system. Figure 15 shows two transducers (e.g. with outputs P1 and P2) that can be continuously monitored by a PC program. All of the ER3000 models can monitor two analog signals, the analog setpoint and external feedback. Some ER3000 series models, as referenced in Section 3 (ER3000 Model Description), can monitor two additional analog signals; the extra input 1 and extra input 2 signals.

Monitoring Extra Input 2 does necessitate the knowledge that this input doubles as the Profile Start/Stop input. The toggle level of Extra Input 2 should be set to its maximum value, 4095, if you do not want the pressure profile to start running. This is simply done by adjusting variable 86 (ID_AD_EXTRA2_TOGGLE) described in section 9.5 (Analog Input Variables).

4.5.7 Networking ER3000's

Up to 32 ER3000's can be networked together, daisychained, as shown in Figure 16. The ER3000's must be set up to different node addresses before being networked together and powered-up. All ER3000's are factory set to node address 250, therefore the address must be changed to allow them to all communicate on the network. Changing the node address is accomplished by wiring an ER3000 as shown in Figure 2 and running the Windows ER3000 program. Once communicating to the ER3000 change the Node Number field in the Miscellaneous Window from 250 to the desired node address. Repeat this process for all nodes.

Note: Power supply must be able to provide 300mA to each ER3000 in the network.

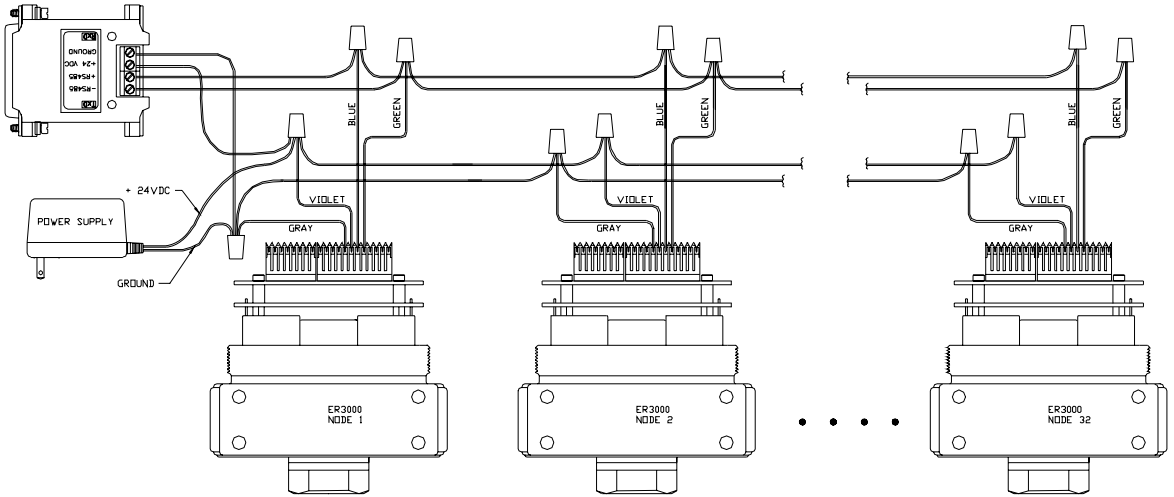


Figure 16: Networking/Daisychaining ER3000's

4.5.8 Digital Outputs

The ER3000's can provide digital outputs to the rest of the system. The outputs can be toggled using a PC computer program or as part of a pressure profile. This can be used to trigger a process in another part of the system or simply turn on a light bulb or sound an alarm.

This feature is only available on ER3000 models that have the digital outputs, as referenced in Section 3 (ER3000 Model Description).

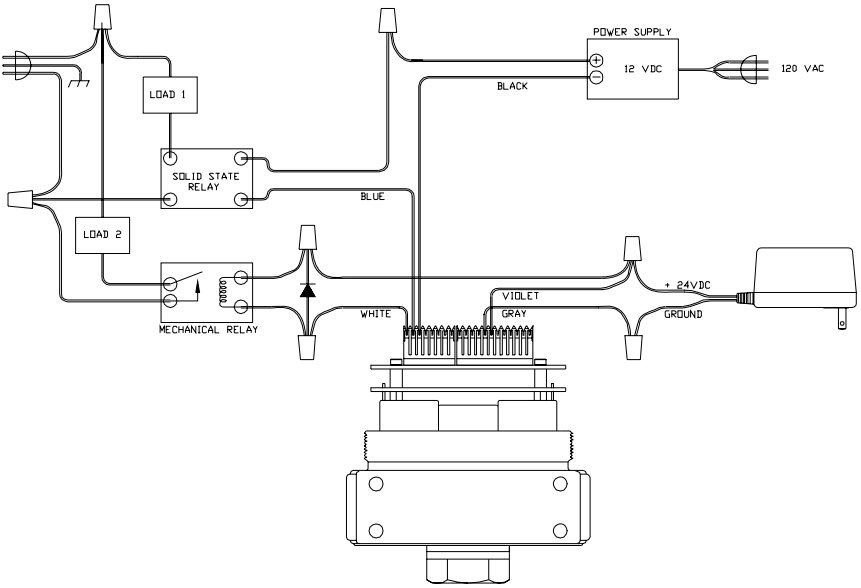


Figure 17: ER3000 Digital Outputs

Output load #1 is shown in Figure 17 using an external supply to switch a 12VDC solid state relay, which controls the load.

Output load #2 is shown in Figure 17 using the ER3000's power supply to switch a 24VDC relay, which controls the load.

4.5.9 Monitor Internal Sensor using the Analog Output

The ER3000 provides the capability of monitoring the internal sensor. Figure 18 shows the 4-20 mA wiring option.

This feature is only available on models that supply the analog output of the internal sensor, as referenced in Section 3 (ER3000 Model Description).

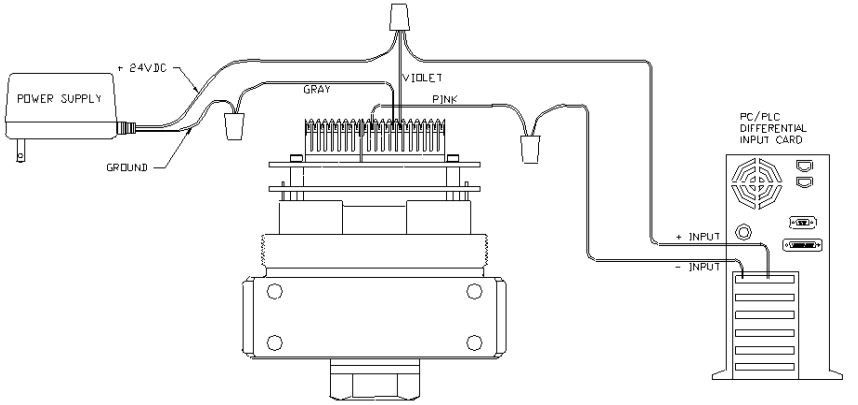


Figure 18: Monitor Internal Sensor (4-20mA wiring)

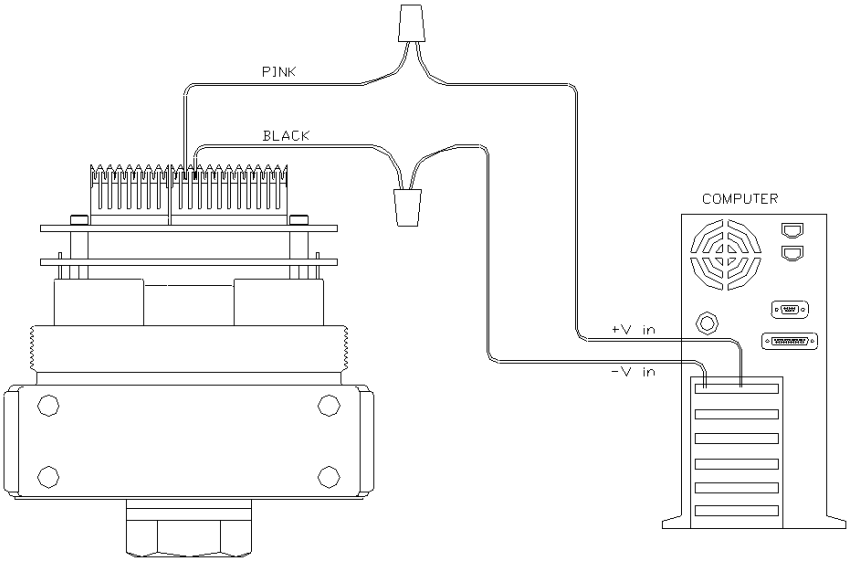


Figure 19: Monitor Internal Sensor (0-10V wiring)
NOTE: Wire power as shown in figures 2 & 3

5. OPERATION

5.1 Theory of operation

The ER3000 is a microcontroller-based device that implements a digital control algorithm to regulate pressure. Supply pressure is allowed into the ER3000 via a pulse-width modulated solenoid valve at the inlet port, and pressure is reduced via a similar valve at the exhaust port (normally the exhaust vents to ambient).

In a typical application, the ER3000 loads the dome of a dome loaded regulator (air to open and a venting type regulator for the purpose of this example) and senses pressure from a transducer mounted downstream in the process, as shown in Figure 3. The ER3000 compares the feedback signal to the setpoint every 25 milliseconds. If the feedback is lower than the setpoint, the ER opens its inlet valve, allowing pressure to flow onto the dome of a pressure reducing regulator. This opens the main valve of the regulator, increasing pressure downstream. The ER3000 will continue to increase pressure on the dome of the regulator, increasing downstream pressure until the feedback signal is equal to the setpoint. If the setpoint is lowered, so that the feedback is now higher than the setpoint, the ER3000 will open its exhaust valve, reducing pressure on the dome of the regulator. This will cause the regulator to self vent, thus lowering downstream pressure. The ER3000 will continue to reduce pressure on the dome of the regulator until the feedback signal is equal to the setpoint.

5.1.1 PID Control

PID (Proportional/Integral/Derivative) control algorithm is widely used in the process industry. The most common example of a PID controller is a temperature controller for an industrial oven. The basic control algorithm can best be described through use of Figure 20:

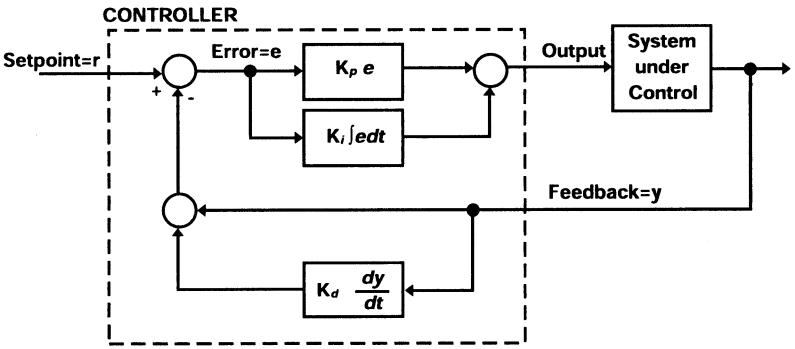


Figure 20: PID Control

In this drawing, the dashed line represents the controller. The setpoint signal, which is input to the controller, represents the desired level of response (the desired pressure in this case). The output, which goes to the "system under control", is the actuating signal to the process (the amount that each valve is opened in this case). The feedback signal represents the measured response of the system (using, for example, a 4-20 mA pressure sensor). Thus, the function of the controller is to analyze the setpoint and the feedback to produce the output signal. This is done in the following manner.

Refer to the Figure 20, ignoring for the moment, the lower block containing the term Kd. We see that the feedback signal is subtracted from the setpoint signal to form the error signal. The error thus represents the deviation of the actual system response from the desired response. The output is then produced by summing two terms. The first term is the product of the error and the constant Kp (the proportional constant). Thus the larger the error the greater the output is. The second term is formed by multiplying the integral of the error times the constant Ki (the integral constant). The effect of the integral is to accumulate the error over time. The effect of even small errors will eventually cause the output to increase over time until the system responds and the error is eliminated.

We return now to the effect of the Kd block in the feedback path. This block multiplies the derivative of the feedback times the constant Kd (the derivative constant). The derivative is sensitive to rapidly changing signals. Its primary function in the control algorithm is to suppress oscillations.

"Tuning" a controller is the process of selecting the optimal Kp, Ki, and Kd constants to yield the "best" response. The "best" response depends on what is most important for a given application and often becomes a compromise between response time and stability.

5.2 Control Modes

The ER3000 provides four modes of operation. These modes depend on whether the feedback signal is derived from the controller's internal pressure sensor, a user supplied external sensor (such as a 4-20 mA pressure transducer) or a combination of the two. The four modes are described in the following sections.

5.2.1 Internal Feedback Mode

The internal feedback mode uses the ER3000's temperature compensated internal sensor to control the output pressure in the 0-100 psig range.

5.2.2 External Feedback Mode

The external feedback mode uses a user supplied external transducer to control the process pressure. This mode is typically used when using the ER3000 to load the dome of a mechanical air actuated regulator or control valve. Control of the

actual process pressure is obtained by installing a pressure transducer at the output of the regulator or valve to provide the feedback signal to the ER3000.

External feedback can also be useful when using the ER3000 as a standalone unit. It may be desirable to measure the pressure downstream from the controller. For example, if the controller's output passes through a length of pipe to a vessel and it is expected that there will be pressure drops in the pipe, then it may be beneficial to install a pressure transducer at the vessel to provide the feedback signal.

5.2.3 Cascade Loop Mode

Cascade loop mode implements one PID loop within another PID loop.

The inner loop uses the controller's internal sensor and the outer loop uses an external sensor. This mode of operation creates more stability, but slows down the response of the system.

(Note - For cascade control it is best to set the Integral Minimum = 0 and Integral Maximum = 32767. This is because it is necessary to maintain a positive pressure on the dome of the regulator to maintain output pressure from the system.)

5.2.4 Manual Mode

In manual mode, no control algorithm is implemented. The setpoint is used to directly control the unit's pulse width modulators. This mode can be useful for system testing.

In Windows ER3000 Signal Generator Screen or DOS Tune a setpoint value of:

0% = Fully opens the exhaust solenoid valve
50% = Closes both solenoid valves.
100% = Fully opens the inlet solenoid valve

In Windows ER3000 Read/Write Screen or DOS ERTALK a setpoint value of:

0x0706 = Fully opens the exhaust solenoid valve
0x0800 = Closes both solenoid valves.
0x08fa = Fully opens the inlet solenoid valve

5.3 Setpoint sources

The setpoint for the unit can be derived from one of three sources. It can be:

- Transmitted over the RS485 interface.
- Input from an analog signal (4-20mA, 1-5V, or 0-10V).
- Supplied by an embedded profile.

5.4 Failsafe Limits

Another function of the ER3000 is to detect when programmable limits are exceeded. Limits can be set on the following variables:

- Analog setpoint.
- Internal feedback.
- External feedback.
- Inner loop error signal.
- Outer loop error signal.

Associated with the limits is a failsafe state that is user defined to set the inlet and exhaust valves in any desirable combination of open and/or closed states. The default failsafe state is to close the inlet valve and open the exhaust valve so that the system will be vented if a limit is exceeded.

Limits can be useful for providing added security in the event of a system failure such as broken transducer wiring, lack of supply pressure, etc. When limits are not desired the failsafe modes should be "disabled" (they are disabled when shipped from the factory).

5.5 LEDs

There are four LEDs (light emitting diodes) on the boards to indicate the status of the unit. The LEDs indicate the ER3000 is fundamentally operating correctly. Refer to the Troubleshooting Section for more details on LED indicators.

5.6 RS485 Communication

RS485 communication provides a low cost yet efficient means of communicating between a computer and a network of ER3000 controllers.

5.6.1 Protocol

In the network the computer serves as a master and all of the controllers as slaves. Each controller must have a unique node number between 1 and 250. Controllers have a default node number of 250 when shipped from the factory. When configuring a network each controller must be individually powered up and have a unique node number assigned, using Windows ER3000 (CVI) or DOS tune.exe. The computer initiates all communication and the controllers respond only to messages that are sent specifically to their node addresses.

The implementation of the Tescom protocol is explained fully in the Software Programs Section of the manual.

6. TUNING PROCEDURE

6.1 Typical Application to Tune

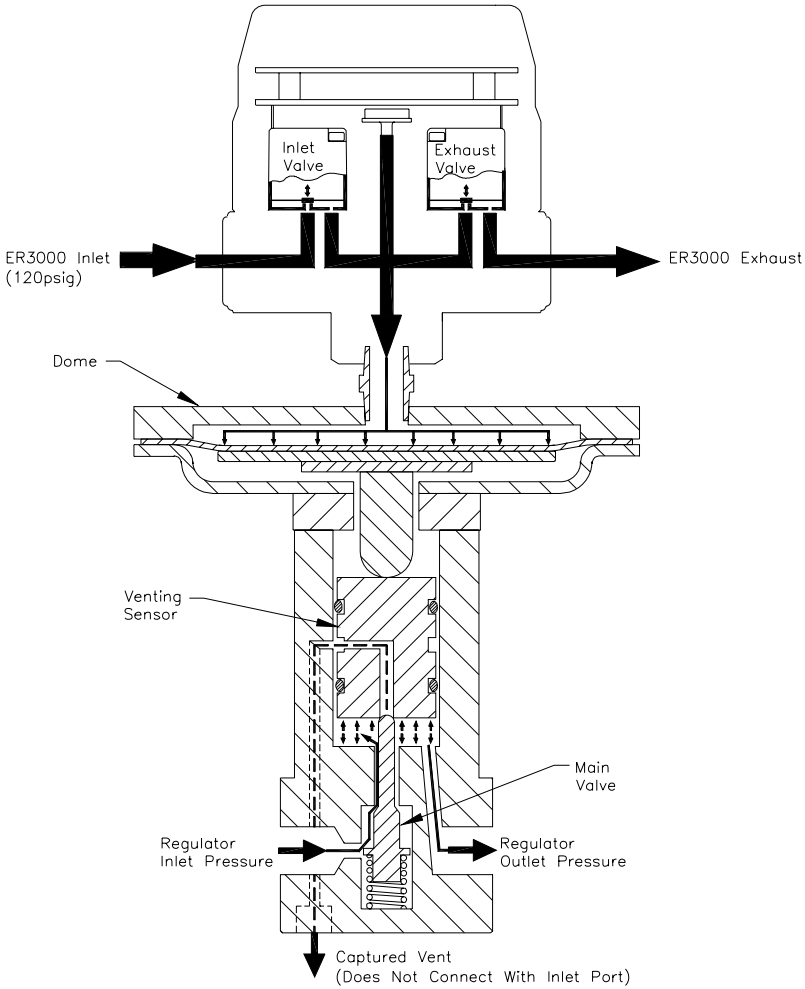


Figure 20: Regulator and ER3000 Internal Operation

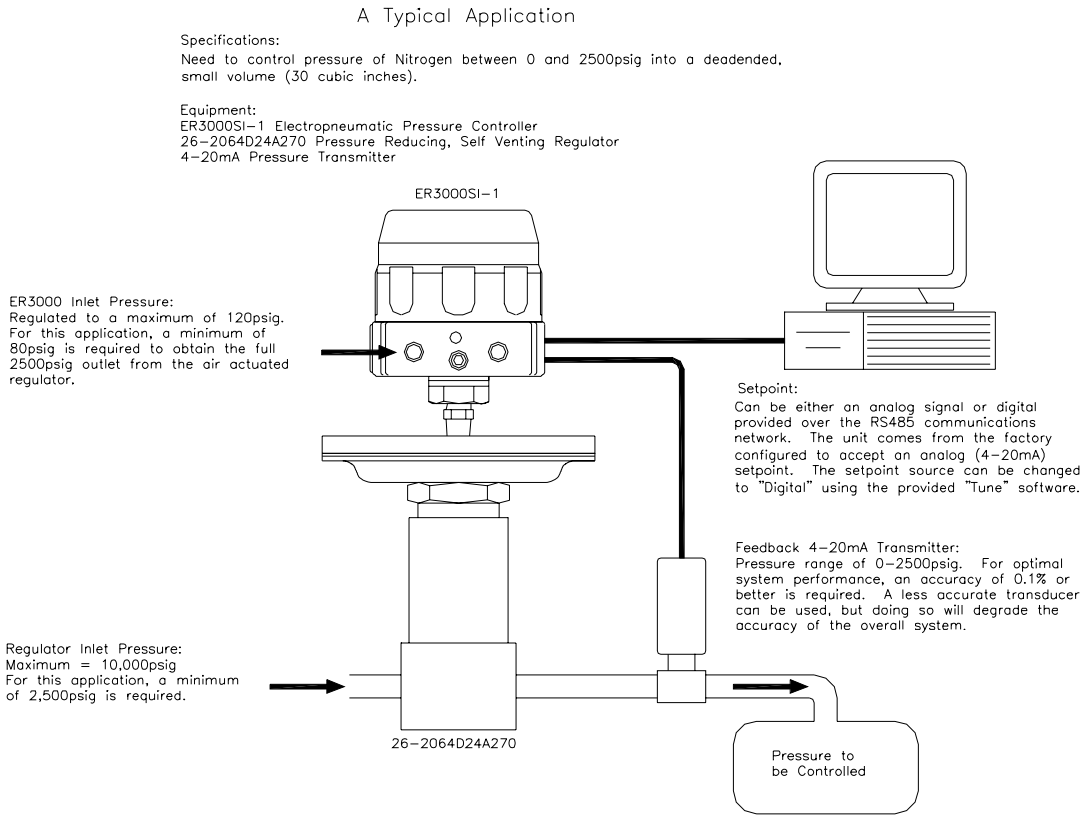

A Typical Application
Specifications:
Need to control pressure of Nitrogen between 0 and 2500psig into a deadended, small volume (30 cubic inches).
Equipment:
ER3000SI−1 Electropneumatic Pressure Controller
26−2064D24A270 Pressure Reducing, Self Venting Regulator
4−20mA Pressure Transmitter
ER3000SI−1
ER3000 Inlet Pressure:
Regulated to a maximum of 120psig. For this application, a minimum of 80psig is required to obtain the full 2500psig outlet from the air actuated regulator.
Setpoint:
Can be either an analog signal or digital provided over the RS485 communications network. The unit comes from the factory configured to accept an analog (4−20mA) setpoint. The setpoint source can be changed to "Digital" using the provided "Tune" software.
Feedback 4−20mA Transmitter:
Pressure range of 0−2500psig. For optimal system performance, an accuracy of 0.1% or better is required. A less accurate transducer can be used, but doing so will degrade the accuracy of the overall system.
Regulator Inlet Pressure:
Maximum = 10,000psig
For this application, a minimum of 2,500psig is required.
26−2064D24A270
Pressure to be Controlled

Figure22: Typical Tuning Application

6.2 Tune the Typical Application

This tuning procedure utilizes the Windows Tuning program ER3000 (CVI) and is taken from the ER3000 (CVI) On Line Help. It applies to the above typical application using external feedback.

To begin, it should be realized that the tuning of PID controllers is learned with experience. However, the following basic concepts should allow the inexperienced user to tune their loops sufficiently for use on a majority of applications.

There are some features of the ER3000 that are unique when compared to other PID controllers that allow the system to be optimized. In particular, the use of four different modes of operation, the setting of minimum values for inlet and exhaust valves (deadband adjust) and the setting of maximum and minimum values for the integral sum allow for greater flexibility in the ER3000 system.

To begin, three windows should be opened:

- Tuning (Advanced!) --- Select 'Gains' in Format Menu
- Signal Generator
- Plot

Each system has unique requirements. Since tuning will always be a compromise between various tradeoffs, it is necessary to decide what are the most important parameters for the given application. Typical goals include the following:

- Maximize speed of response.
- Minimize peak overshoot.
- Minimize offset.
- Minimize settling time.

In addition, the region of operation will affect how the unit is tuned. This application will be operating primarily in the 0 to 2500 psi region. Thus tuning should be performed over this entire range. However, the final setup should be tested in intermediate pressure ranges as well, to verify maximum performance throughout the system's range.

In the Tuning Window, make sure the Control Mode is set to External Feedback and the Sensor Range Minimum and Maximum are 0 and 2500 respectively. The ER3000 is shipped with outer loop PID parameters that have been established at the factory to work well with the regulator in that system, however, in this example we will begin tuning by setting the parameters as follows:

- Proportional: 200.
- Integral: 0.
- Derivative: 0.
- Integral Minimum: 0.
- Integral Maximum: 0.

(Note - For cascade control it is best to set the Integral Minimum = 0 and Integral Maximum = 32767. This is because it is necessary to maintain a positive pressure on the dome of the regulator to maintain output pressure from the system.)

In the Signal Generator, set ‘Setpoint 1’ & ‘Setpoint 2’ to 625 and 1875, which is 25% and 75%. Make sure that the plot screen is set up to show the entire tuning range. For example, with the above setpoints, the display should be set up for 0 to 2500.

Since tuning is generally done using step changes, set up 'Wave Type' for option 'TOGGLE'.

Now click on the "Setpoint 1/Setpoint 2" in the Signal Generator to toggle between the two setpoints.

With the proportional term set to 200, the response will be relatively slow. The first step in tuning is to see how far the proportional term can be increased. In general, increasing the proportional term will decrease the response time (i.e. - make the response wave more square), however a point will be reached at which the effect becomes detrimental. That is, too much proportional term will result in overshoot and possibly ringing of the response. Also, it should be noted that the effect of the tuning parameters (PID) tends to be logarithmic. Thus a possible sequence of values to try for the proportional term might be 200, 400, 800, 1600, until ringing and/or overshoot occurs and then narrow down to an optimal value, one which gives just a slight amount of overshoot and ringing.

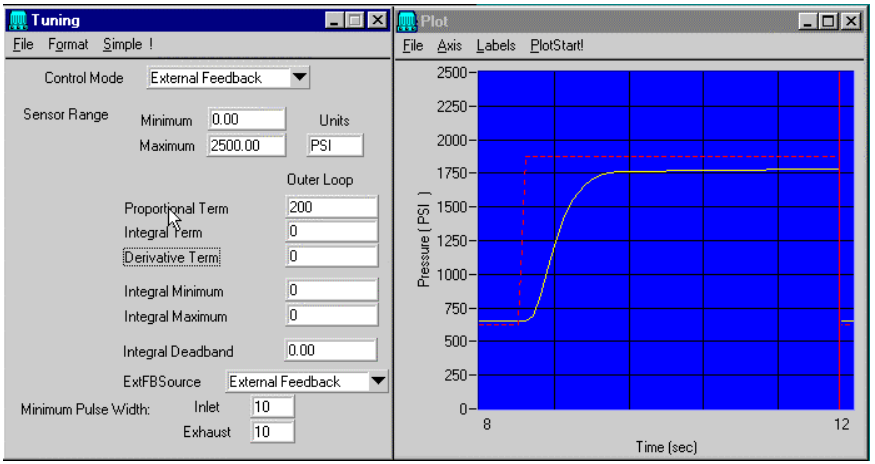
Next the derivative term should be increased so as to reduce the overshoot and ringing in the system. However, too much derivative term may result in a noisy output.

Once the optimal proportional and derivative terms are found, the integral term should be adjusted. The integral term has the effect of eliminating DC offsets, however too much integral will lead to instability (overshoot and ringing). Again the effect is logarithmic so values such as 10, 20, 50, 100, 200, 500, 1000 ... can be tried until an optimal value is obtained.

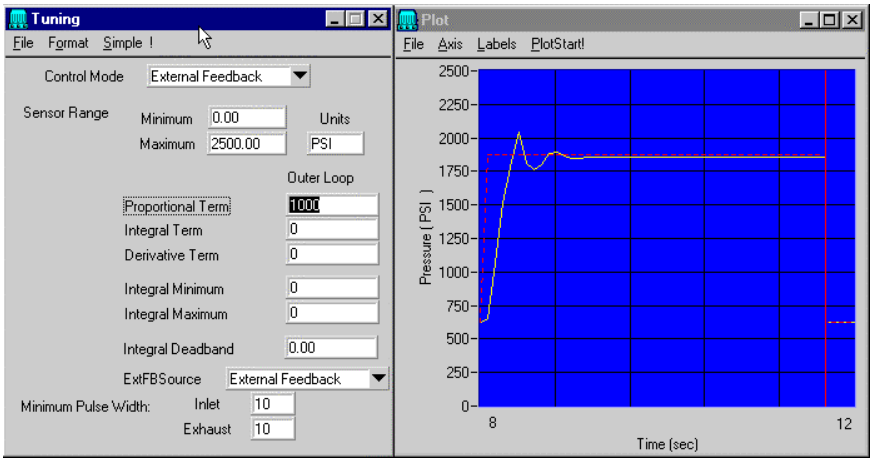
At this point it should be noted that the ER3000 provides a unique integral limiting feature ('Minimum Outer Integral' and 'Maximum Outer Integral'). This allows for using large integral terms without creating excessive overshoot. It should be realized that the integral sum is what holds the valves open even when there is zero error. For closed-ended systems the minimum and maximum integrals can be very small. However, for systems requiring flow it is necessary to keep these values higher. To determine how small they can be made (remember - smaller is better as long as proper flow is maintained) the setpoint should be set to the maximum level and the minimum and maximum reduced until flow is no longer maintained, then slightly increase these values. Often, for closed ended systems a value of one or two is sufficient.

After performing the steps mentioned above, tuning can often be improved by iterating between the various parameters. Although performing basic tuning can be simple, learning to fully optimize the tuning requires experience, so experiment!

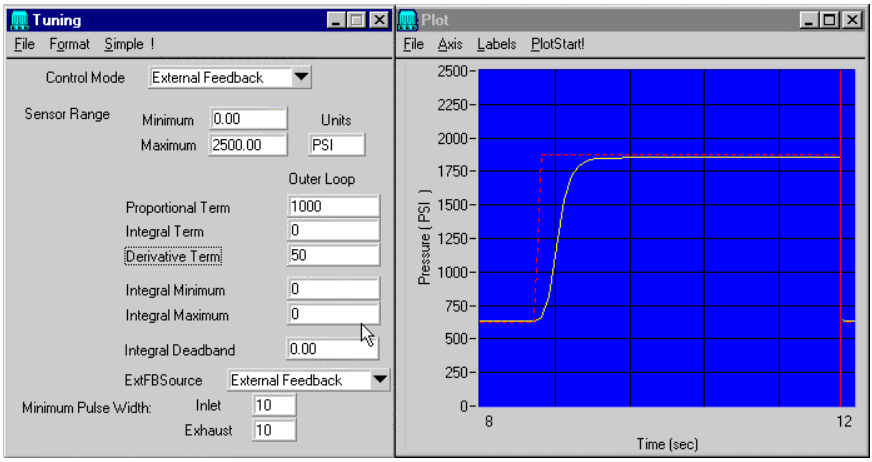
The following is an example sequence of tuning steps. First a very **undertuned** response is shown (note size of proportional term).



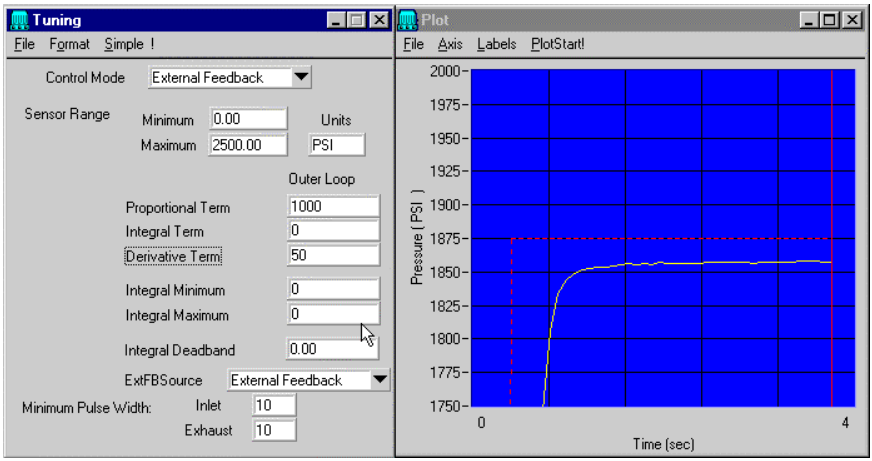
Next the **proportional term is increased**, however, **overshoot** and ringing results:



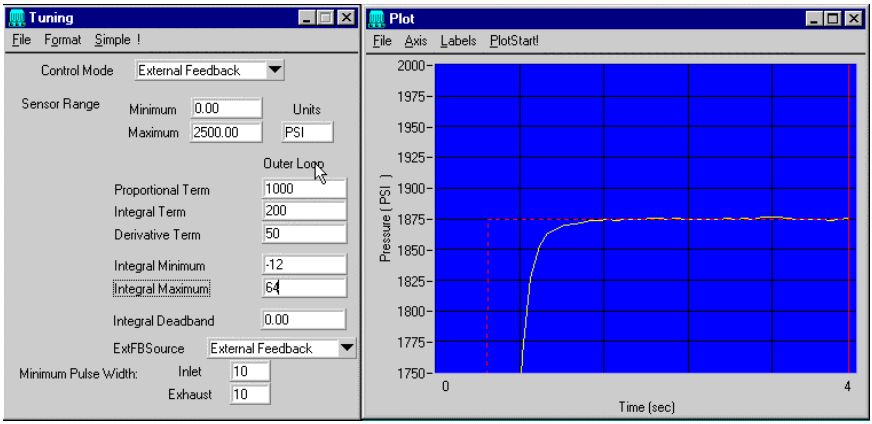
Now, some **Derivative** is introduced. Note the **decrease in overshoot**.



However, if we zoom in on the horizontal axis between 1750 and 2000 psi, we notice that a small **offset** remains.



What can be done to **eliminate the offset** is the **addition of integral term**. The resulting response follows:



The application should now be tuned for the system working in the mode of toggling between 625 and 1875 psi. The system can be fine tuned to optimize speed or stability by adjusting the tuning parameters. The system can be further tuned by selecting different pressure settings and testing the response. The final tuning should be done at pressures that are representative of how the system will be operated.

7. CALIBRATION

The ER3000 is fully calibrated at the factory. The calibration process involves temperature compensation and pressure linearization of the internal pressure sensor, and linearization of both the analog setpoint and external feedback inputs. The additional inputs and outputs on some models, as referenced in Section 3 (ER3000 Model Description), are also linearized. The user is able to adjust the calibration as described in the following sections.

7.1 Zero/span

The calibration of the unit may be changed by adjusting the zero and span settings of the ER3000. The Zero and Span settings are found on the Miscellaneous Screen of the Windows ER3000 program.

Normally, the zero and span do not need adjustment since the unit has been factory calibrated. However, under the following conditions it may be advantageous to make some adjustment:

- The application is using a reduced pressure range.
- The unit is normally operating under nonstandard temperature conditions and it is desired to optimize the calibration for this environment.
- There has been some long-term drift in the calibration.
- An external transducer is being used to provide feedback.

The procedure is as follows:

1. Connect a reference pressure gauge to the output of the ER3000 (or the output of the booster regulator, if one is being used).
2. Set the setpoint (via the analog setpoint input or the RS485 interface as appropriate) to a value close to zero (4.16 mA for analog input or 1% for RS485 interface are recommended).
3. If the reference pressure meter does not indicate 1 psi then increase the zero value to raise the reading or decrease to lower it, as required.
4. Next, set the setpoint to a value close to 100% (19.2 mA for the analog setpoint or 95% for RS485 interface are good values).
5. If the reference pressure meter does not indicate 95 psi then increase the span value to raise the reading or decrease to lower it, as required.
6. Set the setpoint (via the analog setpoint input or the RS485 interface as appropriate) to a value close to zero (4.16 mA for analog input or 1% for RS485 interface are recommended).
7. Verify that the pressure meter indicates 1 psi. If not, then repeat above procedure.

A couple of points should be noted for proper calibration. First, the controller should be properly tuned before performing calibration, if possible. Second, proper time for the pressure to settle to a stable value should be allowed for each step. Finally, if the zero is adjusted too far in the negative direction, then the output will not respond until the zero is raised to within the control range (i.e. - so that the output is above zero psi).

8. SOFTWARE PROGRAMS

8.1 Windows Tune Program

To run the Windows Tune program, click the ER3000 (CVI) icon.

The Tune program is an all encompassing software package which allows the user to address any ER3000 Controller on the RS485 network and provides easy tuning of the ER3000's. Additionally, the Tune program allows you to monitor system operation, alter profiles, specify failsafe limits, enable password protection, read/write internal variables, acquire data, and review previously acquired data.

The basic screens available are; Signal Generator, Plot, Tuning, Profile, Pulse, Failsafe, Data Acquisition, Dacq View, Miscellaneous, Read/Write, and Password.

For more information on the Windows Tune program, see section 6, Tuning Procedure, which uses the Windows Tune Program to explain how to tune the ER3000. Information is also available on the Windows Tune program Help Screens. The help screens are accessed by the Help Menu in the ER3000 Control Window. To access help on a particular Window, right click on the mouse while that Window is highlighted. To get a printout of the Windows Help Screens use the file MANUAL.RTF in the MANUAL subdirectory.

8.2 Windows Example Programs

In the WIN16 and WIN32 directories there are four subdirectories of Windows programs - LabVIEW, Visual Basic, LabWindows (CVI), and "C". In the windows directory (i.e. \WINDOWS) there are two files (tescom.dll, tescom.ini) which are used with any Windows program (see README.DOC file for more information).

The files in the corresponding subdirectories contain simple programs in the LabVIEW, Visual Basic, LabWindows (CVI), and "C" languages, illustrating the use of the tescom.dll (Dynamic Link Library).

There are also two subdirectories, DLL and DLL32. The files in these directories are used to create the 16 and 32 bit versions of the Tescom DLL.

8.3 Tescom Protocol (Provides Custom Software Support)

The Tescom Protocol used to interface to the ER3000 is non-proprietary. A description of the protocol is given in PROTOCOL.DOC in the subdirectory TESCOM2\LIBRARY.

Typically programmers can use the DOS-based library or the Windows-based DLL provided to aid in communicating to the ER3000. However, not all systems

run on these platforms. We provide all the software used in the development of the Tescom Protocol library and DLL. This allows the programmer the ability to alter and recompile the Tescom Protocol in a format suitable for their system.

The Tescom protocol software includes the following six functions:

Startup - This function must be called during program initialization before any other function to allow PC initialization, including the serial port. This function does not send any data to the ER3000. This function needs to be called only once.

WriteNetVar - This function is used to write any of the ER3000 internal variables.

ReadNetVar - This function is used to read any of the ER3000 internal variables.

WriteProfileSegment - This function is used to write any of the ER3000 profile segments, 1-32.

ReadProfileSegment - This function is used to read any of the ER3000 profile segments, 1-32.

Shutdown - This function must be called before exiting the program. This function does not send any data to the ER3000. This function needs to be called only once.

8.3.1 DOS Library

The Tescom protocol, protocol.lib, allows easy access to the ER3000 from a PC for DOS-based C-language programs.

One thing to note is that the LIBRARY directory contains two subdirectories - one for Microsoft libraries and another for Borland. It is important to use the PROTOCOL.LIB file from the directory corresponding to the compiler being used.

Custom DOS applications can be developed easily using the existing software as a baseline. The ERTALK program demonstrates basic communication with the ER3000 and is a good starting point for custom software development. The PROFILE2 program demonstrates the usage of the profiling functions.

8.3.2 Windows DLL

The Tescom protocol, TESCOM.DLL, allows easy access to the ER3000 from a PC for Windows-based programs.

The protocol is available as a 16-bit and a 32-bit DLL. The proper DLL should be placed in the Windows directory when generating custom software (this is automatically done if the Tescom Windows program is installed, ER3000 (CVI)).

Custom Windows applications can be developed easily using the example for the programming environment being chosen. There are examples for C, Visual Basic, LabVIEW, and LabWindows/CVI.

8.3.3 Macintosh Custom Software

The Tescom protocol is provided and written in C. The protocol software can be easily compiled with custom software for the Macintosh. A demo program is also provided to ensure proper system operation and provide an example program using the Tescom protocol software.

8.4 DOS Programs

To run any of the DOS-based programs, type 'C:\TESCOM2\TESCOM' at the DOS prompt and follow the instructions on the display.

Most subdirectories contain a **README.DOC** file describing the files in the directory.

8.4.1 Tune

The program TUNE.EXE provides the user with access to many of the controller's programmable variables. It also includes a graphics screen for displaying the setpoint and feedback. In addition, it includes a function generator for creating waves (square, sine, triangular or sawtooth) that are transmitted as setpoints to the controller.

This program provides a powerful means of tuning the ER3000. Details on its use can be found in the file **tune.doc**.

8.4.2 Ertalk

The program ERTALK.C is a simple program illustrating the use of four of the library functions. It can be used to read or write any of the controller's programmable variables, as outlined in Section 9, "ER3000 Internal Variables".

8.4.3 Profile

The Profile directory contains a set of programs that will allow users to construct complete pressure profiles by writing a DOS batch file. Each program will perform a different profile function (start, ramp, soak or step) and store the setpoint, feedback and time in a file called data.txt. This file can be imported to a program such as Excel to plot the profile. The programs and their descriptions are documented in **README.DOC** residing in TESCOM2\PROFILE directory.

It should be noted that this method of profiling writes to the ER3000 setpoint variable, which is different then the embedded profiling capability of the ER3000. The PROFILE2 program actually downloads pressure profiles into the ER3000 for embedded pressure profiling.

8.4.4 Profile2

The user may use functions such as: ramp, dwell, step, change variable, loop, digital in, and digital out to construct the desired profile (refer to Section 3 (ER3000 Model Description) for models with digital in and digital out). The

profile may then be downloaded into the controller. After profile download, it may be started by software writing variable ID_PROFILE_STATE, a toggle switch, or by the UI3000/UI4000. See the Readme.doc in the profile2 directory for a detailed description of the software.

8.4.5 Data_log

This sample data acquisition program provides basic data collection for the user. The program can be used to read up any of the ER variables and store the information into an output file. Data_log.cfg is used to configure the data collection variables including sample time, number of samples, variables to collect and output file name. See readme.doc in Data_log directory for more information.

8.4.6 Test_pr

Test_pr.exe resides in the Debug directory. This program can be used as a simple test for the user to check for node and serial numbers, version of software, and communication port. This program should be used as part of the troubleshooting steps described in Section 10, Troubleshooting.

9. ER3000 INTERNAL VARIABLES

The ER3000 has a number of internal variables which can be accessed via the RS485 interface. The most commonly used variables are listed below. The variable index number, name, and description are shown. The index number is the value that is entered in the DOS-based ERTALK program or the Read/Write Screen of the Windows-based ER3000 (CVI) program to access the specified variable. A complete list of internal variables is shown in the table at the end of this section.

9.1 Setpoint and Feedback Variables

37 ID_SETPOINT - This is the controller's setpoint.

43 ID_SETPOINT_FLAG - This variable determines the source of the setpoint, variable 37 (ID_SETPOINT).

0 => setpoint from A/D, analog setpoint input
1 => setpoint from RS485 network, typically a PC.
2 => setpoint from internal pressure profile

44 ID_FEEDBACK - This is the controller's overall feedback signal. For internal sensor mode it is the same as inner feedback. For external sensor mode or cascade mode it equals the outer loop feedback.

87 ID_EXT_FEEDBACK_SOURCE - This variable determines the source of the external feedback.

0 => feedback from the compensated external sensor, see variable 5.
1 => feedback from extra analog input 1, see variable 77.

Note: For both setpoint and feedback a value of 400 counts is 0% and 3700 counts is 100%. To convert between counts and percent, use the following formulas:

value_percent = (value_counts - 400) * 100 / 3300.
value_counts = (value_percent * 3300 /100) + 400.

9.2 Configuration Variables

9 ID_CONTROL_MODE - This variable establishes the control mode for the controller. A value of four only occurs when a failsafe condition exists due to a failsafe limit being exceeded (see variables 54 to 64). A value of five only occurs if the controller is in ESTOP, emergency stop, mode.

0 => internal feedback mode.
1 => external feedback mode.
2 => cascade mode.
3 => manual mode.
setpoint = 0x08fa => inlet open
setpoint = 0x0800 => solenoids closed
setpoint = 0x0706 => exhaust open
4 => failsafe mode (read only)
5 => emergency stop (read only)

42 ID_NODE - This is the unit's network node address. Note that if this variable is changed then all future communication must be addressed to the new node address.

52 ID_SERIAL_NUMBER - This is the serial number for the unit. It is programmed at the factory and should not be changed by the user.

53 ID_VERSION_NUMBER - This is the version number of the embedded software.

9.3 Inner Loop Tuning Variables

35 ID_INNER_PROPORTIONAL_CONSTANT - This is the P-term, proportional constant, for the inner loop.

28 ID_INNER_INTEGRAL_CONSTANT - This is the I-term, integral constant, for the inner loop.

3 ID_INNER_D_COEF1 - This is the D-term, derivative constant, for the inner loop.

50 ID_INNER_INTEGRAL_MINIMUM - This is the minimum value allowed for the integral sum on the inner loop.

29 ID_INNER_INTEGRAL_MAXIMUM - This is the maximum value allowed for the integral sum on the inner loop.

30 ID_INNER_INTEGRAL_SUM - This is the value of the integral sum for the inner loop. It is formed by multiplying the integral constant time the error and summing the result with the previous value for the integral sum.

66 ID_INNER_INTEGRAL_DEADBAND - This is the inner loop minimum error required for the integral sum to be changing in value. Often it is set to zero and has no effect. However, if it is desirable to stop integrating once the error is reduced below a certain value, for instance when using an external dome-loaded regulator which has hysteresis, then this parameter should be set to the minimum acceptable error.

6 ID_COMPENSATED_INTERNAL_SENSOR - This is the compensated internal sensor value, i.e. - after temperature compensation, zero and span have been applied to the raw signal. A value of 400 is 0% and 3700 is 100%.

9.4 Outer Loop Tuning Variables

25 ID_OUTER_PROPORTIONAL_CONSTANT - This is the P-term, proportional constant, for the outer loop.

21 ID_OUTER_INTEGRAL_CONSTANT - This is the I-term, integral constant, for the outer loop.

16 ID_OUTER_D_COEF1 - This is the D-term, derivative constant, for the outer loop.

49 ID_OUTER_INTEGRAL_MINIMUM - This is the minimum value allowed for the integral sum on the outer loop.

22 ID_OUTER_INTEGRAL_MAXIMUM - This is the maximum value allowed for the integral sum on the outer loop.

23 ID_OUTER_INTEGRAL_SUM - This is the value of the integral sum for the outer loop. It is formed by multiplying the integral constant time the error and summing the result with the previous value for the integral sum.

67 ID_OUTER_INTEGRAL_DEADBAND - This is the outer loop minimum error required for the integral sum to be changing in value. Often it is set to zero and has no effect. However, if it is desirable to stop integrating once the error is reduced below a certain value, for instance when using an external dome-loaded regulator which has hysteresis, then this parameter should be set to the minimum acceptable error.

9.5 Analog Input Variables

1 ID_AD_SETPOINT - This is the value of the analog setpoint. A value of 400 is 0% and 3700 is 100%. Note that the analog setpoint is not used unless the controller is programmed to use it (see variable #43).

5 ID_COMPENSATED_EXTERNAL_SENSOR - This is the compensated external sensor value, i.e. - after linearization, zero and span have been applied to the raw signal. A value of 400 is 0% and 3700 is 100%.

77 ID_COMPENSATED_EXTRA_AD1 - This input is available only on certain models, refer to section 3. This is the compensated external analog input value, i.e. - after linearization has been applied to the raw signal.

78 ID_COMPENSATED_EXTRA_AD2 - This input is available only on certain models, refer to section 3. This is the compensated external analog input value, i.e. - after linearization has been applied to the raw signal.

85 ID_AD_EXTRA1_TOGGLE - This variable is used to adjust the level that the ER3000 interprets the ID_COMPENSATED_EXTRA_AD1 variable as a logical 0 or a logical 1.

86 ID_AD_EXTRA2_TOGGLE - This variable is used to adjust the level that the ER3000 interprets the ID_COMPENSATED_EXTRA_AD2 variable as a logical 0 or a logical 1.

9.6 Pressure Profile Control Variables

69 ID_PROFILE_TYPE - This is the type of the profile step currently active.

0 => STOP
1 => RAMP
2 => STEP
3 => DWELL
4 => DIGITAL OUTPUT
5 => DIGITAL INPUT
6 => LOOP
7 => CHANGE VARIABLE

70 ID_PROFILE_STATE - This is the run state of the profile.
0 => STOP
1 => START
2 => RUN

71 ID_PROFILE_STEP - This is the step in the profile which is currently being run.

119 ID_UI_PROFILE_STARTRUN - This is the restarting mode of the profile.
0 => Restart profile at the beginning.
1 => Resume profile at current profile step.

9.7 Single "Puff" Solenoid Control Variable

73 ID_PULSE - This variable allows opening the inlet or exhaust for the specified duration for one pulse period. After one pulse duration, the variable is returned to a value of 0.
0x08fa => Inlet full open.
0x0800 => Both valves closed.
0x0706 => Exhaust full open.

9.8 Pulse Mode Variables

81 ID_PULSE_PERIOD - This controls the rate of the pulse while pulse mode is active. The value represents how many passes through the control algorithm (25ms per pass) before sending a pulse to one of the solenoids.

82 ID_PULSE_WIDTH - This controls how long the solenoid is held open while pulse mode is active. Part of this number compensates for allowed system fluctuations (or noise) so too small a number will not open the solenoid valve.

83 ID_PULSE_DEADBAND - This is the error from the setpoint allowed for the pulse function to stop pulsing. This value is in counts read up from the sensor. One count of error is .03% and typically this number is in the range of 0-3.

84 ID_PULSE_ENABLE - This turns the pulse function ON(1) or OFF(0).

9.9 Scaling Variables

108 ID_UI_UNITS_CHAR1 109 ID_UI_UNITS_CHAR2 110 ID_UI_UNITS_CHAR3 111 ID_UI_UNITS_CHAR4	The "units" variables are used by supplied software to display the pressure range units (i.e. psi.).
114 ID_UI_SCALE_MIN_LO 115 ID_UI_SCALE_MIN_HI 116 ID_UI_SCALE_MAX_LO 117 ID_UI_SCALE_MAX_HI	The scale minimum and scale maximum variables are used by supplied software to show minimum and maximum ranges.

9.10 Analog and Digital Output Variables

88 ID_DIGITAL_OUTPUT1 - This variable can be written directly by a program or by the embedded profile using the Digital Output command. This variable is written to Digital Output #1, shown in Table 2, Auxiliary Cable Assembly.

89 ID_DIGITAL_OUTPUT2 - This variable can be written directly by a program, by the embedded profile using the Digital Output command, or by the embedded code. The embedded code updates this output if variable ID_TTL_FLAG enables this output as a within tolerance indicator. If enabled, ID_TTL_ERR0 and ID_TTL_ERR4095 variables are used to set the maximum error allowed, in counts, for a setpoint of 0 and 4095 counts, respectively. The embedded code interpolates between these points to find the maximum error allowed for all other setpoint values. Reference ID_SETPOINT and ID_FEEDBACK to translate between counts and percent. This variable is written to Digital Output #2, shown in Table 2, Auxiliary Cable Assembly.

90 ID_DIGITAL_OUT1_INIT - Power-up state of ID_DIGITAL_OUT1.

91 ID_DIGITAL_OUT2_INIT - Power-up state of ID_DIGITAL_OUT2.

92 ID_DA_ANALOG_OUT - This is the value written to the D/A converter to generate the 0-10V or 4-20mA output signal.

93 ID_TTL_ERR0 - Maximum error allowed at 0 counts, see variable 89.

94 ID_TTL_ERR4095 - Maximum error allowed at 4095 counts, see variable 89.

96 ID_TTL_FLAG - This variable enables(1) or disables(0) the usage of ID_DIGITAL_OUTPUT2 as a within tolerance indicator.

9.11 PWM Control Variables

12 ID_PWM_SHUTOFF_FLAG – This flag is only active if ID_RTTASK_DELAY (variable #13) is not a 0 or 1 and designates what the ER3000 will send to the PWM every 25ms while it is delaying.

0 => Write the previously computed value to the PWM

1 => Write a 0 to the PWM.

13 ID_RTTASK_DELAY – This variable is set to 0 typically, allowing the control algorithm to generate a new value for the PWM every 25ms. Certain systems need a slower acting control system which is allowed by with this variable, for example writing a 4 to this variable will allow the control algorithm to compute a new PWM value every 100ms.

19 ID_INNER_SENSOR_MIN – This variable operation is typically disabled by writing a 0 to it. If not disabled, it allows for a minimum internal pressure. If the internal pressure is below the specified value the exhaust valve will not be opened to decrease the pressure.

20 ID_INNER_SENSOR_MAX – This variable operation is typically disabled by writing a 4095 to it. If not disabled, it allows for a maximum internal pressure. If the internal pressure is above the specified value, the inlet valve will not be opened to increase the pressure.

34 ID_OUTPUT - This is the value of the output from the controller. It is this value which controls the ER3000's valves. A positive number will open the inlet valve and a negative number will open the outlet valve.

46 ID_SOLENOID - This variable determines which valve is open when the output is positive or negative. In normal mode, (0 => Normal) positive outputs open the inlet solenoid and negative outputs open the exhaust solenoid. In reversed mode, (1 => Reversed) positive outputs open the exhaust solenoid and negative outputs open the inlet solenoid. This is useful in reverse acting systems (i.e. - in systems where increasing the pressure causes the process variable to decrease).

47 ID_MIN_INLET - This is the minimum value for the inlet pulse width modulator. The pulse width modulator's value ranges from 0 to 250. This variable (along with variable #48) sets the deadband for the system. This variable is solenoid dependant and typically a value close to 10. Larger values can give tighter regulation, but at a cost of more gas being exhausted.

48 ID_MIN_EXHAUST - This is the minimum value for the exhaust pulse width modulator. The pulse width modulator's value ranges from 0 to 250. This variable (along with variable #47) sets the deadband for the system. This variable is solenoid dependant and typically a value close to 10. Larger values can give tighter regulation, but at a cost of more gas being exhausted.

65 ID_PWM_VALUE - This is the value which is controlling the Pulse-Width Modulators for the solenoids. Positive values represent the inlet solenoid opening and negative values are for the exhaust solenoid. A value of +/- 250 represents a 100% duty cycle (full on).

9.12 Gain/Offset Variables

39 ID_GAIN - This is the gain value. This value in conjunction with the offset (variable #40) is used to form the feedback signal (see variable #44):

feedback = gain * compensated_reading + offset.

0x0200 => 1/8 (.2% adjustability)
0x1000 => 1 (.025% adjustability)
0x8000 => 8 (.003% adjustability)

40 ID_OSET - This is the offset value. This value in conjunction with the gain (variable #39) is used to form the feedback signal (see variable #44):

feedback = gain * compensated_reading + offset.

0x0000 => -1/2 FS
0x0fff => +1/2 FS

9.13 Failsafe Variables

64 ID_PWM_FAILSAFE - This variable establishes the failsafe state of the unit which is established if any of the programmed limits is

exceeded. Normally, the unit will be set up to open the exhaust and close the inlet valve if a limit is exceeded. Also note, when shipped from the factory the limits are set to their limits (i.e. - disabled). The unit will automatically remove itself from failsafe if the failsafe limit is no longer exceeded.

0 => IN_CLOSED_EX_CLOSED
1 => IN_OPEN_EX_CLOSED
2 => IN_CLOSED_EX_OPEN
3 => IN_OPEN_EX_OPEN

Failsafe Limits for Specified Signals These variables are the minimum and maximum values allowed for a given signal that is permissible before tripping a limit and causing the unit to go into failsafe.	
Minimum/Maximum	**Limited Signal**
54 ID_MIN_AD_SETPOINT 55 ID_MAX_AD_SETPOINT	1 ID_AD_SETPOINT
56 ID_MIN_COMPENSATED_INTERNAL_SENSOR 57 ID_MAX_COMPENSATED_INTERNAL_SENSOR	6 ID_COMPENSATED_INTERNAL_SENSOR
58 ID_MIN_COMPENSATED_EXTERNAL_SENSOR 59 ID_MAX_COMPENSATED_EXTERNAL_SENSOR	7 ID_COMPENSATED_EXTERNAL_SENSOR
60 ID_MIN_INNER_ACTUAL_ERROR 61 ID_MAX_INNER_ACTUAL_ERROR	0 ID_INNER_ACTUAL_ERROR
62 ID_MIN_OUTER_ACTUAL_ERROR 63 ID_MAX_OUTER_ACTUAL_ERROR	14 ID_OUTER_ACTUAL_ERROR

9.14 Table of all ER3000 Internal Variables

Table 3: ER3000 Internal Variables

Variable Name and Number		Type	Range:Decimal	Range:Hex
0 - ID_INNER_ACTUAL_ERROR	*	Signed	-4095 : 4095	-0fff : 0fff
1 - ID_AD_SETPOINT	*	Unsigned	0 : 4095	0 : 0fff
3 - ID_INNER_D_COEF1		Signed	-32,768 : 32,767	-8000 : 7fff
4 - ID_INNER_D_COEF2	-	Unused	---	---
5 - ID_COMPENSATED_EXTERNAL_SENSOR	*	Unsigned	0 : 4095	0 : 0fff
6 - ID_COMPENSATED_INTERNAL_SENSOR	*	Unsigned	0 : 4095	0 : 0fff
7 - ID_RAW_EXTERNAL_SENSOR	*	Unsigned	0 : 4095	0 : 0fff
8 - ID_RAW_INTERNAL_SENSOR	*	Unsigned	0 : 4095	0 : 0fff
9 - ID_CONTROL_MODE		Signed	0 : 3	0 : 3
10 - ID_INNER_DERIVATIVE	*	Signed	-32,768 : 32,767	-8000 : 7fff
11 - ID_INNER_EFFECTIVE_ERROR	*	Signed	-32,768 : 32,767	-8000 : 7fff
12 – ID_PWM_SHUTOFF_FLAG		Unsigned	0 : 1	0 : 1
13 - ID_RTTASK_DELAY		Unsigned	0 : 65535	0 : ffff
14 - ID_OUTER_ACTUAL_ERROR	*	Signed	-4095 : 4095	-0fff : 0fff
16 - ID_OUTER_D_COEF1		Signed	-32,768 : 32,767	-8000 : 7fff
17 - ID_OUTER_D_COEF2	-	Unused	---	---
18 - ID_OUTER_EFFECTIVE_ERROR	*	Signed	-32,768 : 32,767	-8000 : 7fff
19 - ID_INNER_SENSOR_MIN		Unsigned	0 : 4095	0 : 0fff
20 - ID_INNER_SENSOR_MAX		Unsigned	0 : 4095	0 : 0fff
21 - ID_OUTER_INTEGRAL_CONSTANT		Signed	-32,768 : 32,767	-8000 : 7fff
22 - ID_OUTER_INTEGRAL_MAXIMUM		Signed	-32,768 : 32,767	-8000 : 7fff
23 - ID_OUTER_INTEGRAL_SUM		Signed	-32,768 : 32,767	-8000 : 7fff
25 - ID_OUTER_PROPORTIONAL_CONSTANT		Signed	-32,768 : 32,767	-8000 : 7fff
26 - ID_FACTORY_MIN_INLET		Unsigned	0 : 250	0 : fa
27 - ID_FACTORY_MIN_EXHAUST		Unsigned	0 : 250	0 : fa
28 - ID_INNER_INTEGRAL_CONSTANT		Signed	-32,768 : 32,767	-8000 : 7fff
29 - ID_INNER_INTEGRAL_MAXIMUM		Signed	-32,768 : 32,767	-8000 : 7fff
30 - ID_INNER_INTEGRAL_SUM		Signed	-32,768 : 32,767	-8000 : 7fff
34 - ID_OUTPUT	*	Signed	-32,768 : 32,767	-8000 : 7fff
35 - ID_INNER_PROPORTIONAL_CONSTANT		Signed	-32,768 : 32,767	-8000 : 7fff
37 - ID_SETPOINT		Unsigned	0 : 4095	0 : 0fff
38 - ID_RAW_TEMP_SENSOR	*	Unsigned	0 : 4095	0 : 0fff
39 - ID_GAIN		Unsigned	0 : 65,535	0 : ffff
40 - ID_OSET		Unsigned	0 : 65,535	0 : ffff
41 - ID_ARDG	*	Unsigned	0 : 65,535	0 : ffff
42 - ID_NODE		Unsigned	1 : 250	1 : fa
43 - ID_SETPOINT_FLAG		Signed	0 : 2	0 : 2
44 - ID_FEEDBACK	*	Unsigned	0 : 4095	0 : 0fff
46 - ID_SOLENOID_DIRECTION		Signed	0 : 1	0 : 1
47 - ID_MIN_INLET		Unsigned	0 : 250	0 : fa
48 - ID_MIN_EXHAUST		Unsigned	0 : 250	0 : fa
49 - ID_OUTER_INTEGRAL_MINIMUM		Signed	-32,768 : 32,767	-8000 : 7fff
50 - ID_INNER_INTEGRAL_MINIMUM		Signed	-32,768 : 32,767	-8000 : 7fff
51 - ID_RAW_AD_SETPOINT	*	Unsigned	0 : 4095	0 : 0fff
52 - ID_SERIAL_NUMBER		Unsigned	0 : 65,535	0 : ffff
53 - ID_VERSION_NUMBER		Unsigned	0 : 65,535	0 : ffff
54 - ID_MIN_AD_SETPOINT		Unsigned	0 : 4095	0 : 0fff

* - Denotes Read Only, all other variables are Read/Write.

Table 3 (continued): ER3000 Internal Variables

Variable Name and Number		Type	Range:Decimal	Range:Hex
55 - ID_MAX_AD_SETPOINT		Unsigned	0 : 4095	0 : 0fff
56 - ID_MIN_COMPENSATED_INTERNAL_SENSOR		Unsigned	0 : 4095	0 : 0fff
57 -ID_MAX_COMPENSATED_INTERNAL_SENSOR		Unsigned	0 : 4095	0 : 0fff
58 - ID_MIN_COMPENSATED_EXTERNAL_SENSOR		Unsigned	0 : 4095	0 : 0fff
59-ID_MAX_COMPENSATED_EXTERNAL_SENSOR		Unsigned	0 : 4095	0 : 0fff
60 - ID_MIN_INNER_ACTUAL_ERROR		Signed	-32,768 : 32,767	-8000 : 7fff
61 - ID_MAX_INNER_ACTUAL_ERROR		Signed	-32,768 : 32,767	-8000 : 7fff
62 - ID_MIN_OUTER_ACTUAL_ERROR		Signed	-32,768 : 32,767	-8000 : 7fff
63 - ID_MAX_OUTER_ACTUAL_ERROR		Signed	-32,768 : 32,767	-8000 : 7fff
64 - ID_PWM_FAILSAFE		Signed	0 : 3	0 : 3
65 - ID_PWM_VALUE	*	Signed	-250 : 250	-fa : fa
66 - ID_INNER_INTEGRAL_DEADBAND		Unsigned	0 : 4095	0 : 0fff
67 - ID_OUTER_INTEGRAL_DEADBAND		Unsigned	0 : 4095	0 : 0fff
68 - ID_FEEDBACK_FILTER		Unsigned	0 : 1	0 : 1
69 - ID_PROFILE_TYPE	*	Unsigned	0 : 7	0 : 7
70 - ID_PROFILE_STATE		Unsigned	0 : 2	0 : 2
71 - ID_PROFILE_STEP	*	Unsigned	0 : 31	0 : 1f
72 - ID_ESTOP_FLAG		Unsigned	0 : 1	0 : 1
73 - ID_PULSE		Unsigned	1798 : 2298	0706 : 08fa
74 - ID_EXTRA_AD1	*	Unsigned	0 : 4095	0 : 0fff
75 - ID_EXTRA_AD2	*	Unsigned	0 : 4095	0 : 0fff
76 - ID_DAC		Unsigned	0 : 65,535	0 : ffff
77 - ID_COMPENSATED_EXTRA_AD1	*	Unsigned	0 : 4095	0 : 0fff
78 - ID_COMPENSATED_EXTRA_AD2	*	Unsigned	0 : 4095	0 : 0fff
79 - ID_RANGE_MIN_INLET		Unsigned	0 : 20	0 : 14
80 - ID_RANGE_MIN_EXHAUST		Unsigned	0 : 20	0 : 14
81 - ID_PULSE_PERIOD		Unsigned	0 : 200	0 : c8
82 - ID_PULSE_WIDTH		Unsigned	0 : 250	0 : fa
83 - ID_PULSE_DEADBAND		Unsigned	0 : 330	0 : 14a
84 - ID_PULSE_ENABLE		Unsigned	0 : 1	0 : 1
85 - ID_AD_EXTRA1_TOGGLE		Unsigned	0 : 4095	0 : 0fff
86 - ID_AD_EXTRA2_TOGGLE		Unsigned	0 : 4095	0 : 0fff
87 - ID_EXT_FEEDBACK_SOURCE		Unsigned	0 : 1	0 : 1
88 - ID_DIGITAL_OUTPUT1		Unsigned	0 : 1	0 : 1
89 - ID_DIGITAL_OUTPUT2		Unsigned	0 : 1	0 : 1
90 - ID_DIGITAL_OUT1_INIT		Unsigned	0 : 1	0 : 1
91 - ID_DIGITAL_OUT2_INIT		Unsigned	0 : 1	0 : 1
92 - ID_DA_ANALOG_OUT		Unsigned	0 : 255	0 : 0ff
93 - ID_TTL_ERR0		Unsigned	0 : 4095	0 : 0fff
94 - ID_TTL_ERR4095		Unsigned	0 : 4095	0 : 0fff
95 - ID_DA_ANALOG_WRITE_FLAG		Unsigned	0 : 1	0 : 1
96 - ID_TTL_FLAG		Unsigned	0 : 1	0 : 1
98 – ID_SENSOR_FLAG		Unsigned	0 : 1	0 : 1

* - Denotes Read Only, all other variables are Read/Write.

Most of the following variables are used exclusively by the UI3000/UI4000. The exceptions are the sensor range variables, 108-111 and 114-117, and the profile restart, variable 119. The profile restart variable is the only one that is used by the embedded software.

Table 3 (continued): ER3000 Internal Variables

Variable Name and Number		Type	Range:Decimal	Range:Hex
100 - ID_UI_INIT	#			
101 - ID_UI_LOCK_FLAG	#			
102 - ID_UI_PASSWORD_ENABLE	#			
103 - ID_UI_USER_PASSWORD	#			
104 - ID_UI_GRAPH_MIN	#			
105 - ID_UI_GRAPH_MAX	#			
106 - ID_UI_GRAPH_TIME	#			
107 - ID_UI_GRAPH_CONTINUOUS	#			
108 - ID_UI_UNITS_CHAR1		Unsigned	0 : 255	0 : ff
109 - ID_UI_ UNITS_CHAR2		Unsigned	0 : 255	0 : ff
110 - ID_UI_ UNITS_CHAR3		Unsigned	0 : 255	0 : ff
111 - ID_UI_ UNITS_CHAR4		Unsigned	0 : 255	0 : ff
112 - ID_UI_REMOTE_SP1	#			
113 - ID_UI_REMOTE_SP2	#			
114 - ID_UI_SCALE_MIN_LO		float %	0 : 65,535	0 : ffff
115 - ID_UI_ SCALE_MIN_HI		float %	0 : 65,535	0 : ffff
116 - ID_UI_ SCALE_MAX_LO		float %	0 : 65,535	0 : ffff
117 - ID_UI_ SCALE_MAX_HI		float %	0 : 65,535	0 : ffff
118 - ID_UI_SP1OR2_FLAG	#			
119 - ID_UI_PROFILE_STARTRUN		Unsigned	0 : 1	0 : 1
120 - ID_UI_DECIMAL_POSITION	#			
121 - ID_UI_BACKLIGHT	#			
122 - ID_UI_CONTRAST	#			

- Denotes usage by the UI3000/UI4000 only, all other variables are Read/Write.
% - Denotes 32-bit floating point numbers for the scale_min and scale_max variables.

10. TROUBLESHOOTING

10.1 LED Indicators

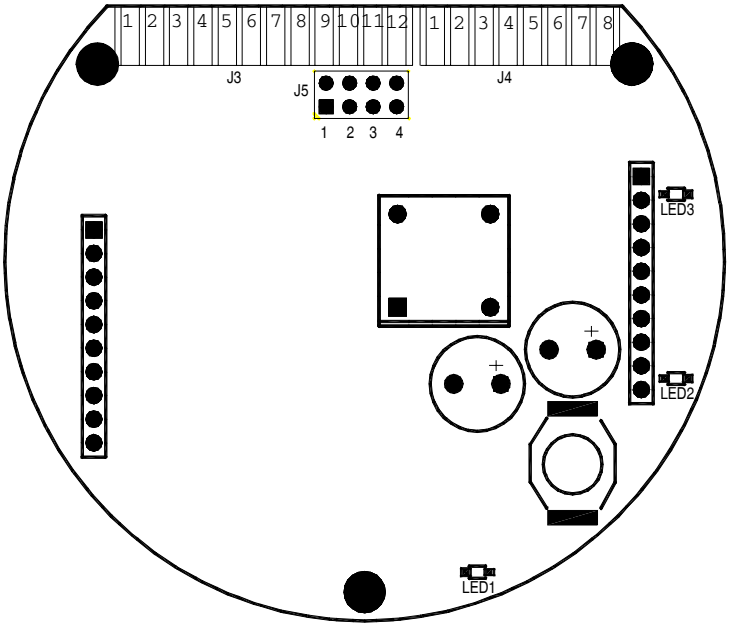


Figure 21: LED Locations

Table 4: LED Indicators
Terminal (Top) Board LED1, red = On continuously, if power is supplied to the ER3000. LED2, green = On if ER3000 is sending data out, via RS485. LED3, amber = On if ER3000 is receiving data in, via RS485. Micro (Bottom) Board LED1, red = blinks "heartbeat" if system is functioning properly.

Additionally, the Micro (Bottom) Board LED, LED1, blinks once per second, staying on more than off, when the system is functioning properly. If this LED is on or off continuously then the electronics are not functioning. This LED will also blink at a different rate, twice a second, if the zero or span buttons have been pressed too long, causing their corresponding limits to be exceeded. If a failsafe limit has been exceeded, the LED will also blink once per second, but will be off more than on.

10.2 Third Party RS232/RS485 Converters

The RS232/RS485 converters range in modes of operation. The provided Tescom software needs the RS232/RS485 converter to be configured in the following mode.

Table 5: Third Party RS232/RS485 Converter Mode
Echo off. Transmitted data, SD, is used for flow control. No handshake control (RTS/CTS, DSR/DTR). Additionally, for 4-wire RS422 converters (half duplex). Connect: +TD to +RD. Connect: -TD to -RD.

10.3 ER3000 Power-up Test, using LED Indicators

Power up the ER3000 without any Tescom provided software packages running. Check the LED indicators on the ER3000.

Table 6: LED's, Power Up
Terminal (Top) Board LED1, red = ON LED2, green = OFF LED3, amber = OFF Micro (Bottom) Board LED1, red = BLINKING

If the LED indicators are not as specified in Table 6, refer to Figure 2 to ensure proper wiring. Check power wiring if the red LED's are off. Check the RS485 wiring if the amber LED is on. Check to ensure no jumper is on J3 of the micro (bottom) board if the green LED is on. If not using a Tescom RS485/RS232 converter, refer to Table 5 for proper mode of operation.

If unable to resolve the problem, contact your local distributor. A list of Tescom distributors may be found on our website, www.tescom.com, or by contacting the factory.

10.4 ER3000 Data Communications Test, using LED Indicators

For Windows

These procedures assume

- You have followed the instructions in Sections 4.4.3 thru 4.4.6 to run the Windows Tune program.
- You are using a Tescom converter or some other converter that has TxD & RxD indicator lights. If you are not using a Tescom converter, refer to Table 5 for proper setup
- The test above, "Power-up Test of the ER3000, using LED Indicators", works.

- If the "**Comm Error**" window pops up, click on "Search Network". As the program scrolls through the nodes, check the TxD light on the converter.
    - If it is not blinking, you are not connected to that comm port. When the search is completed, change the comm port and repeat until you find the correct comm port.
    - If it is blinking,

      Check the LED indicators on the ER3000.

Table 7: LED's, Data Transfer
Terminal (Top) Board
LED1, red = ON
LED2, green = BLINKING
LED3, amber = BLINKING
Micro (Bottom) Board
LED1, red = BLINKING

      If the LED indicators are not as specified in Table 7, refer to Figure 2 to ensure proper wiring. If the amber LED, LED3, is OFF, suspect the wrong COM port setting. If the amber LED, LED3, is BLINKING and the green LED, LED2, is OFF, suspect the wrong node address.

- If the error message "**Tescom Startup failed. DLL may be in use by another application**", click "OK" and use the 'Channel Selection' box to change the comm port. Repeat the above step.
- If you try all 4 comm ports without success then try the following:
    1. Go to Device Manager: Depending on your operating system, it may be in MyComputer\Control Panel\System\Hardware\Device Manager
    2. Click on "Ports" – this will list all the comm ports on your computer.
    3. If your communications port is higher than 4, you will need to go to the Tescom.ini file and change it there. This file is installed automatically during the Windows Tune installation. It is found in the windows directory on your computer hard drive.
    4. After changing the comm port in the file, save the file and run Windows Tune.
- If after trying the comm port found in the Device driver, you are still unable to establish communications, run Hyperterminal (typically found in Programs\Accessories\Communications).
    1. A "Connection Description" box will open for a new connection. Enter any name, such as "abc" and click "OK".
    2. A "Connect To" box titled "abc" will open. Use the drop-down menu at "Connect Using:" to connect to the comm port in question (i.e. COM2). Click "OK".

- If the port is in use by another application then the error message “Unable to open COM2” will appear. That port will have to be freed up before it can be used by the ER3000 software.
- If a connection box does appear, check the LED indicators on the ER3000

For DOS

This procedure assumes:

- The Tescom “ER3000 User Software” CD, DOS install has been installed
- The communications hardware is configured, as shown in Figure 2.
- The test above, “Power-up Test of the ER3000, using LED Indicators”, works.

- Run ERTALK by Typing: “\tescom2\tescom 1” at a DOS prompt (i.e. C:\>).
- Type in the node address (250 if unknown).
- Select “1” to “Read ER-3000”.
- Type “44” for parameter index, any parameter works.
- If “Node x : Variable Number 44 = ...” scrolls on the screen, communication to the ER3000 is working. Otherwise, “Error” is scrolling, **LET IT SCROLL**.

If unable to resolve the problem, contact your local distributor. A list of Tescom distributors may be found on our website, www.tescom.com, or by contacting the factory.

10.5 Pressure Control Problems

If there is a problem with controlling the pressure:

- Check for pneumatic connections: the inlet pressure (max:120 psig) must go into the inlet port (marked “IN” on the unit). The gauge port must be plugged if gauge not installed.
- Check the control mode and setpoint source using the provided software.
- Check the values of the PID parameters using the provided software.
- Check the unit’s calibration: see the Calibration Section for details.

10.6 Acceptable Resistance Values

The resistance values must be measured with all external wiring disconnected, including the power. Ensure converter screw terminals are tight.

10.6.1 ER3000 RS485 Interface

- +RS485 to GND = 10KΩ to 50KΩ
- -RS485 to GND = 10KΩ to 50KΩ

10.6.2 Converter RS485 Interface

- +RS485 to GND = 3K to 5KΩ
- -RS485 to GND = 900Ω to 1.2KΩ

10.7 Leak Test

The ER3000 can be leak tested using the DOS Tune program or the Windows ER3000(CVI) program. Prior to running the leak test, ensure the following items are done.

- ER3000 wired up and communicating to the computer.
- 100psi is applied to the inlet of the ER3000.
- The outlet port of the ER3000 is plugged.

10.7.1 Windows ER3000 Program

Setup Screens as Shown in Table			
Tuning	**Signal Gen.**	**Plot**	**Misc.**
Control Mode: Manual Sensor Range: 0/100 (Min/Max)	Signal Type: Toggle Setpoint 1: 0 Setpoint 2: 50	Axis, Vertical: -5/105 (Min/Max) Axis, Time: 5	Span: 100 Zero: 0 (Need not be exact)

Procedure:

- Open "PLOT" and "SIGNAL GENERATOR" Screens
- Click on Setpoint 1, wait until feedback reaches 0
- Click on Setpoint 2
- Watch the feedback signal for 25 seconds, it should remain constant

  If feedback increases, the inlet solenoid is leaking
- Change Setpoint 1 to 100
- Click on Setpoint 1
- Wait for feedback to stabilize, which takes approximately 5 seconds
- Click on Setpoint 5
- Watch feedback signal for 25 seconds, it should remain constant

  If feedback decreases, the unit is leaking
- If leaking, plug exhaust port with finger and release

  If pressure buildup at exhaust, then exhaust solenoid is leaking

10.7.2 DOS Tune Program

Main Screen Settings				Setup Screen Settings	
i = 50 j = 0 l = toggle m = -5	Setpoint #1 Setpoint #2 Wave Type Display, Lower	n = 105 o = 5 w = 0 x = 100	Display, Upper Timebase Sensor Range, Low Sensor Range, High	a = 100 (approx.) b = 0 (approx.) c = Manual d = Digital	Span Zero Mode Setpoint Source

Procedure:

- From the TUNE Main Screen, select 'b' to run plot.
- Press "spacebar" to toggle Setpoint to 0.
- Wait until Feedback reaches 0.
- Press "spacebar" to toggle Setpoint to 50.
- Watch the Feedback (FB) signal for 25 seconds.

  If feedback increases, the inlet solenoid is leaking
- Change 'j' (Setpoint #2) to 100.
- Press "spacebar" to toggle Setpoint to 100.

• Wait for Feedback to stabilize, which takes approximately 5 seconds.
• Press “spacebar” to toggle Setpoint to 50.
• Watch Feedback signal for 25 seconds.

If feedback decreases, the unit is leaking

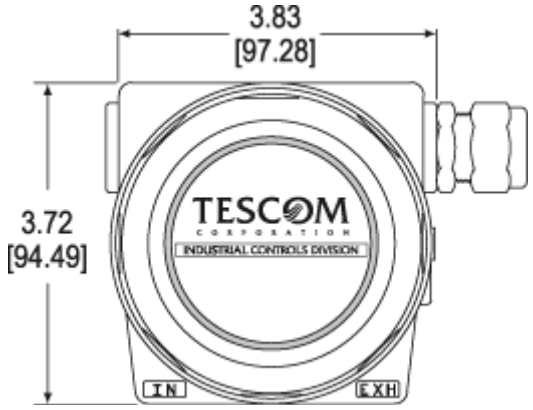
• If leaking, plug exhaust port with finger and release

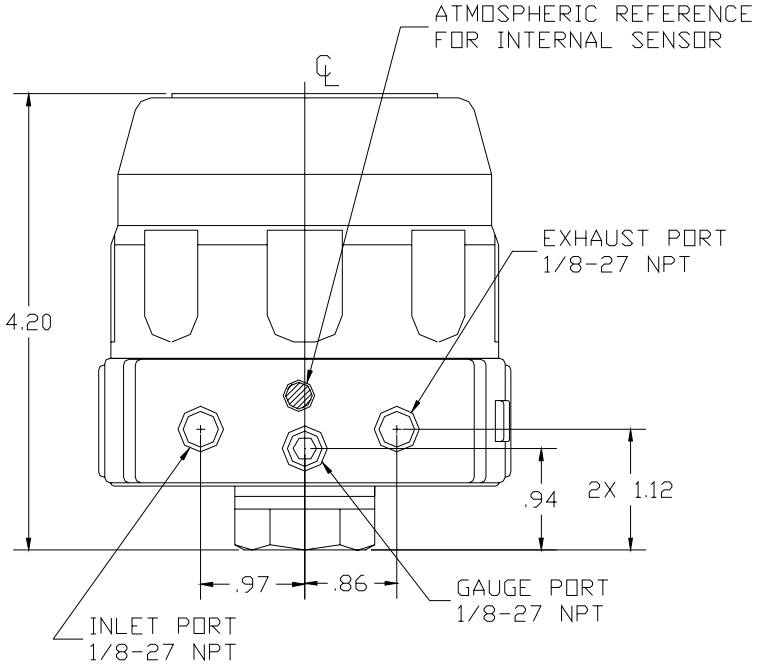
If pressure buildup at exhaust, then exhaust solenoid is leaking

11. ER3000 Accessories

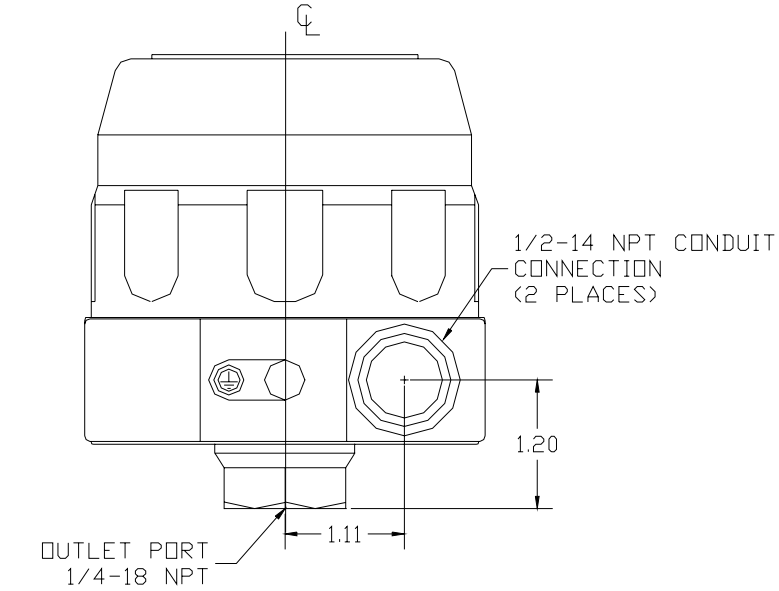
Part #	Description
82699	12 pin MTA (connector only)
85138-X	12 wire cable assembly (5, 10, 20, 50 and 100 foot options)
85121	12 wire cable assembly – 24”
85139-X	8 wire cable assemble (5, 10, and 20 foot options)
85122	8 wire cable assembly – 24”
85137	Fitting Kit (includes ¼”x 1/8” NPT, ¼”x ¼” NPT, and a male tube connector)
80279	Filter
85145	Filter Kit
82575-25	250 mA/24VDC Power Supply
82575-50	500 mA/24VDC Power Supply
85061	RS232 to RS485 converter
82948	USB to RS485 converter
82919	Potentiometer with digital display

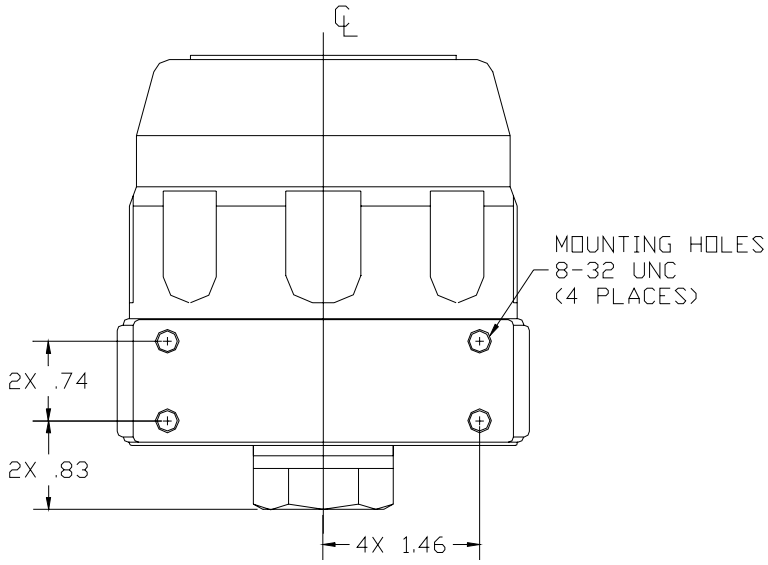
12. MECHANICAL DIMENSIONS OF ER3000





NOTE: DIMENSIONS ARE IN INCHES AND ARE FOR REFERENCE ONLY





NOTE: DIMENSIONS ARE IN INCHES AND ARE FOR REFERENCE ONLY

CE Declaration of Conformity

Manufacturer's Name:	Tescom Corporation
Manufacturer's Address:	12616 Industrial Boulevard Elk River, Minnesota 55330-2491 United States of America
European Contact:	Marc Lembcke TESCOM EUROPE GMBH & CO. KG An der Trave 23-25 23923 Selmsdorf Germany +49/38823/31-0

declares that the product:

Product Name:	Electronic Pressure Controller
Model Number:	ER3000

to which this declaration relates, is in conformity with the relevant EU Directives listed below:

EU EMC Directive 89/336/EEC

using the relevant section of the following EU standards and other normative documents:

EN55011	Limits and measurements of RFI for Industrial, Scientific and Medical (ISM) Equipment
EN50082-2	Generic Immunity for Heavy Industrial Environment

Approval: Jim Tomczak

Title: Vice President &
Chief Financial Officer

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